

Evaluation of a Formal Certification Process for NASA Program and Project Managers

Response to NIAT Action Item 2.1B

**NASA Academy of Program and Project
Leadership**

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INTRODUCTION

In terms of numbers of dollars or of men, NASA has not been our largest national undertaking, but in terms of complexity, rate of growth, and technological sophistication it has been unique...It may turn out that [the space program's] most valuable spin-off of all will be human rather than technological: better knowledge of how to plan, coordinate, and monitor the multitudinous and varied activities of the organizations required to accomplish great social undertakings.

Dael Wolfe, Editorial in *Science*
November 15, 1968

In December 2000, the NASA Chief Engineer's Office released the NASA Integrated Action Team's report on *Enhancing Mission Success: A Framework for the Future* (NIAT Report). This report was commissioned to address recommendations contained in a series of earlier reports chartered in response to Mars Program failures, Shuttle wiring problems, and a generic assessment of NASA's approach to executing "faster, better, cheaper" projects. The recommendations contained in those reports not only addressed root and contributing causes of specific problems and failures, but also looked beyond those incidents to make broader recommendations to the Agency on ways it might improve its general approach to executing programs and projects.

One of the actions called for in the NIAT Report is an evaluation of the "advisability of a formal NASA certification process for Program/Project Managers" (NIAT Action 2.1B). In supporting the need for an evaluation of PM certification, the NIAT pointed out that the issue of certifying project managers was raised by several of the earlier reports. For instance, the *Report on Project Management in NASA* by the Mars Climate Orbiter Mishap Investigation Board (March 13, 2000) concluded that:

The success of a mission often depends on having the right people, starting with the project manager. Proper training and experience of all personnel is essential. We recommend that project managers be selected based on experience gained on prior missions and an ability to lead people (good communication skills, teambuilding capabilities, etc.). They should then receive additional training through on-the-job mentoring from experienced managers and possibly from recently retired experts, and through a formal certification process in project management training. Certification should not be based on having taken the right courses. It should be based on training, but more importantly, on demonstrated, successful project management experience.

The purpose of this evaluation of PM certification is to specify options for NASA, and determine the advantages and disadvantages of a certification process. Further, in order for the Agency to make an informed decision on PM certification, the NIAT Report stipulates that the evaluation include a *benchmark study* with industry and Government organizations on their approaches to certification of program and project managers and experiences with it. This evaluation of PM certification, therefore, is intended to provide NASA with a benchmark of current industry

standards, a review of pros and cons for certification of NASA's program and project managers, and an assessment of the potential impacts of certification on the Agency.

Background – NASA's Project Managers

NASA has always made program and project management a central tenet of its approach to completing complex, multifaceted and highly technical missions. Borrowing concepts of program/project management from the military in the late 1950's, NASA recognized that having an effective project management workforce was critical to the undertakings of the Agency (NASA, 1994). From the Agency's beginning, project managers were tapped to direct the day-to-day work on NASA's missions and were responsible for overall mission success. Although most of NASA's first project managers were scientists, NASA began placing engineers in these positions on many of the earliest missions (Naugle, 1991).

The early years of NASA witnessed the rapid evolution of a variety of systems and techniques for directing the combined efforts of thousands of individuals cooperating in close-knit programs in which Government, university, and private industry played mutually reinforcing roles. Many of the major learning experiences gained from NASA's earliest missions, such as the Apollo management system, were subsequently applied to the next generation of projects (NASA, 1994). At the same time, with the success of the Apollo program and its unmanned mission precursors, it became recognized outside the Agency that one of the valuable byproducts of the U. S. space program was the body of knowledge concerning management of large complex development project activities (Kloman, 1972).

Although the commitment to project management was clear from the Agency's beginning, program administrators discovered early on the difficulty in determining how managers could best be selected, trained, and rotated (Kloman, 1972). Compounding this problem was an inability to identify qualifications that distinguished the ideal candidate for project management assignments from other types of managers. In 1970, NASA commissioned the National Academy of Public Administration to study ways to improve and refine the Agency's project management techniques. After extensive research and interviews, however, the study found no scientific basis for drawing conclusions on the kinds of personal characteristics, skills, or management styles that best lend themselves to the responsibilities of being a program or project manager (Chapman, Pontious & Barnes, 1971).

In practice, NASA's project managers have always been differentiated from other management positions in the Agency. First, these individuals have typically been engineers or technicians with no formal background or training in management. Second, their roles have primarily been involved with guiding cost, schedule and technical aspects of an engineering project having a definite beginning and end. Finally, these individuals have not been directly involved, as an engineering manager would be, in directing the day-to-day technical decisions about design, development and testing of engineering systems, nor have they been responsible for a functional area that provides an ongoing product or service, such as marketing, accounting or manufacturing (Duarte, Lewis, Hoffman & Crossman, 1995).

Preparation of project managers has been a conscious undertaking throughout NASA's history. For much of its early history, NASA had a tradition of using individual managers as the "conduit" for the transfer of project management learning experience. Writing about the history of project management on the *Surveyor* and *Lunar Orbiter* missions, Kloman (1972) pointed out that:

Although each manager setting out on a new task may view his assignment as a completely new departure, he is actually part of a continuum. Just as he brings to his task his own past knowledge and experience, so his colleagues bring theirs. The successful project manager is one who is able to provide the kind of leadership that effectively taps this experience, focusing a common effort upon common goals through a progression of commonly accepted intermediary steps.

Until the *Challenger* accident in 1986, NASA continued to rely on this tradition of preparing project managers by transferring “lessons learned” from manager to manager, and using on-the-job experiences supplemented with targeted training for specific skills. However, after the *Challenger* accident and other problems like the Hubble Space Telescope mirrors, people both within and outside of NASA began to question whether the project management workforce was qualified to manage the development and operation of large complex systems. These incidents led NASA to reevaluate its approach to preparing project managers, and to develop an extensive training and development program aimed at increasing the skills and abilities of NASA’s program and project management workforce. An outgrowth of this effort was the establishment and implementation of the Program and Project Management Initiative (PPMI) in 1989.

From the beginning, the PPMI was focused on establishing a robust and relevant project management training curriculum. The PPMI goal was to build sound fundamental skills by providing a base of knowledge and competence through timely and thorough education and training. These fundamental skills would then be developed and further enhanced through years of incrementally more challenging work assignments and on-the-job experience. Capability would be nourished through simulations and learning on increasingly challenging work, with an abundance of experienced mentors ready and willing to offer guidance, tips and encouragement. The result would be a better-prepared future generation of NASA project professionals. NASA in 1990 was still in the tradition of implementing large, expensive, long duration programs and projects, and PPMI’s initial project manager career development efforts were clearly in line with this tradition.

The project management culture of NASA changed dramatically in 1992, however, when NASA Administrator Dan Goldin challenged NASA and its industry and academic partners to use a Faster, Better Cheaper (FBC) approach to project management. In a speech to NASA employees, Goldin stated, “tell us how we can implement our missions in a more cost-effective manner. How can we do everything better, faster, cheaper, without compromising safety?”

This emphasis on a FBC project management approach subsequently translated into the launch of large numbers of relatively small, low-cost spacecraft. For example, the average spacecraft development cost will have gone from \$590 Million in the FY 1990-94 period, to \$86 Million over the FY 2000-04 period, and the average development time will be reduced from 8 years to 3 years during the same periods. As a result, the number of annual missions launched during FY 2000-04 will be 11, up from only 2 annual launches during the FY 1990-04 period. FBC also changed the demands on NASA’s project managers. A recent audit report on FBC by the NASA Office of Inspector General (2001) noted that:

By using FBC to manage programs/projects, NASA has attempted to change not only the way project managers think, but also the way they conduct business.

As FBC project management began to take hold at NASA, budget cuts and organizational changes mandated by the Government Performance and Results Act of 1993 (GPRA) and the 1993 National Performance Review had a major impact on the Agency. Through the 1990's NASA lost a significant number of experienced and seasoned program and project managers. Driven by employee buy-outs, hiring freezes, restructuring and redeployments, NASA experienced a 26% overall reduction in civil service employees at all levels between FY 1993 and FY 1998. Many of the more senior positions held by middle managers and supervisors were particularly affected by this downsizing, and NASA witnessed the staff-to-supervisor ratio rise from 5.4 to 1 in 1993, to 11 to 1 in 1998.

In the early 1990's, the vast majority of NASA's project managers were "home grown." In 1993, for example, three out of four of NASA's senior project managers had started as entry-level engineers in an engineering organization, and all had worked for NASA by the middle stage of their career (Duarte et al, 1995). The majority of these project managers had been with the Agency for 15 to 25 years, and these were the "mentors" who were being asked to pass on their knowledge and wisdom from lessons learned to prepare the next generation of project managers.

By 1998, as reported in the NASA Workforce Restructuring Plan, NASA had more scientists and engineers over the age of 70 than below the age of 25. The number of scientists and engineers under age 35 leaving NASA was three times greater than the intake of the same age group over the prior several years. During the post-Challenger period, FY 1988 through 1991, the hiring of scientists and engineers averaged about 1,000 per year. However, the number of scientists and engineers hired over the whole period from FY 1992 through 1997 totaled only 1,150, and that trend was projected to continue.

By the mid-1990's, the group of senior project managers represented an "age lump" of personnel, all about the same age, who joined NASA in the 1970's and 80's. As often happens with an age lump phenomenon (Downs, 1967), NASA has experienced a crisis of continuity as these individuals retire, exacerbated by early retirements and buy-outs that characterized the downsizing of NASA since 1993. A recent report on the FBC policy by the NASA Office of Inspector General (2001) noted that:

By 1998, the effects of NASA's downsizing efforts began to take their toll. The downsizing affected program delivery because managers could not recruit new staff to correct skill imbalances and to bring new ideas to the workforce. In addition, the Agency-wide buyouts encouraged the loss of highly experienced managers and created a void in management and technical expertise.

In the wake of criticisms launched as a result of high profile failures in the Mars Program, coupled with reports of wiring issues on the Shuttle, NASA Administrator Dan Goldin testified to the Senate Subcommittee on Science, Technology, and Space in March 2000 that NASA had experienced "less than desired effectiveness" of project management and systems engineering practices with respect to the failed missions. In that testimony, he reported that:

At a time of major cultural change and a rapid increase in the number of programs underway, programs were staffed with next-generation program managers without, in some instances, ensuring that they had been adequately trained and mentored, both in

terms of resources for lessons learned from past experiences and the use of revolutionary new tools and techniques.

The Inspector General's FBC policy report further noted that, faced with budget cuts and downsizing since the mid-1990s, NASA was focused on overall staff reduction and had not given sufficient consideration to the alignment of human resources with its strategic goals. The workforce had been reduced, resulting in a loss of experienced personnel in all skill categories. As a result, NASA had not determined the appropriate number of staff and competencies needed to effectively carry out strategic goals and objectives for its programs and was now at risk of losing core competencies. It has been noted that 25 percent of today's most experienced managers will reach retirement age in 2005. The Inspector General's report concluded that:

As part of workforce planning, management should consider how best to retain valuable employees, plan for their eventual succession, and ensure continuity of needed skills and abilities.

After reviewing the reports on recent failures, the NIAT concluded that NASA must invest in enabling team competency and improving personnel development capability to ensure an adequate foundation for future programs and projects. Ensuring that the team has the right people with the right skills at critical times during the life of the project is essential. NASA has always provided outstanding professional development opportunities that have facilitated the establishment of knowledgeable project teams whose skills have been developed through hands-on experience supplemented by training. The simultaneous increase in projects accompanied by a reduction in experienced practitioners, however, demands greater attention to the process of developing and supporting the workforce. Viewed in the context of a decade of Agency downsizing that has depleted the corps of senior, experienced project managers and mentors, and the need to find a mechanism to build the competence of the next generation of project managers, the NIAT concluded that an evaluation of certification as an option was warranted. Certification was seen to represent a more stringent and rigid application of professional development standards by requiring formal compliance with standards before an individual could be selected for a position.

From PPMI to the Academy of Program and Project Leadership

Until the *Challenger* accident in 1986, NASA did not have a formal training program for program and project managers. In 1989, NASA established the Program and Project Management Initiative (PPMI) to "develop and maintain world-class program and project managers." The purpose of PPMI was to develop education and training programs to enhance the project management knowledge and skill development that project managers were gaining from on-the-job experiences.

The advent of significant changes in the NASA project management environment in 1992 brought about by the FBC emphasis, caused NASA to focus increasingly on the need for a formal career development process. Several internal NASA studies had concluded that NASA needed a "project management career model that informs the NASA project management workforce about skill requirements and on-the-job experiences at different stages in their careers (Duarte et al, 1995, p. 150)."

In 1993, NASA commissioned an extensive study aimed at developing a career model for project managers. The study documented knowledge, skills, abilities and experiences necessary for project management success in the NASA environment, and outlined training and development experiences useful for project managers, and for those individuals aspiring to become project managers. The study also identified the typical career paths of NASA project managers that followed a course of four levels or “stages.” These stages included:

- Stage 1: *Getting Established* (e.g., project team member)
- Stage 2: *Independent Contributor* (e.g., subsystem project manager)
- Stage 3: *Technical Lead/Manager* (e.g., system project manager)
- Stage 4: *Organizational Sponsor* (e.g., program manager)

The study also produced recommendations for the types and sequence of job positions and experiences appropriate to develop project managers at the different stages or levels. Subsequently, conclusions derived from the study were used to drive the development and refinement of NASA’s project manager career development process, as well as the training opportunities and experiences offered through PPMI. The study’s conclusions about project management career development at NASA included (NASA, 1993):

- On-the-job experience, especially hands-on hardware experience, is vital early in the individual’s career;
- Diversity of project experiences and assignments is necessary to prepare the project manager to serve as a “broad generalist;”
- Developing project managers should take advantage of formal training courses to learn basic skills that complement on-the-job training, and prepare them for the next career position; and
- Interpersonal skills are just as important as technical skills for project success. A project manager’s ability to manage a team and effectively communicate with key players is critical to dealing with inevitable conflicts arising on highly complex projects.

The transition from a NASA “initiative” to a formal training “academy” was promoted by Administrator Goldin as part of an effort to cultivate program and project managers who could adapt to the new project environment with a significantly different mindset and methodology. In 1999, the PPMI became formally known as the **NASA Academy of Program and Project Leadership** (APPL). The purpose of APPL was to provide total team and individual professional development support through training, developmental activities and tools for the organizational benefit of developing and maintaining “world-class” practitioners of project management in advance of NASA’s requirements. APPL’s mission called for the delivery of five distinct, but complementary services to achieve excellence in program and project management for NASA, including:

- **Project Management Development Process (PMDP):** Focuses on the success of individual managers by providing a voluntary career development process for NASA employees involved in projects at any level. The process tracks individual progress through four tiers of development.

- **Project Management Curriculum:** Offers more than 20 dynamic and timely residential and Center-based courses to meet the demands of all levels of program and project staff. Some of the courses offer Graduate credits through accreditation by the American Council on Education.
- **Project Management Online Tools and Information Technology:** Supports project managers' needs for quick access to information essential for their job by providing on-line access through the APPL Web-site to answers to questions and coaching in specific interest areas from NASA experts.
- **Performance Support for Intact Teams:** Delivers customized, in-depth training designed to provide just-in-time training to meet the goals and objectives of project teams.
- **Research, Studies and Publications:** Promotes continuous learning by offering a variety of publications, including the ASK Journal, NASA Project Team Study, Team Benchmarking, and Issues in Project Management.

Establishing a NASA Project Management Development Process

The new FBC era for NASA projects in the 1990's also placed an emphasis on doing more with less – greatly increasing the volume of project work --- and doing it in a way that emphasized safety, innovation, low cost, speed, and quality. As a result, it was no longer reasonable for PPMI/APPL to generate coursework and other learning experiences without a clear link to factors associated with mission success and requirements. A major effort was undertaken to identify the core competencies required for success at different stages of a project manager's career.

Using the results of the 1993 study, PPMI/APPL developed an individualized approach to preparing project managers that centered on a formal career development strategy linking critical project competencies to NASA-sanctioned learning and education. Equally important, it was the first time NASA had conducted a systematic analysis of project management requirements and curriculum content that allowed human resources and learning experiences to be tied directly to mission success. This project management training approach eventually became known as the NASA Project Management Development Process, or PMDP. In 1995, after gaining additional input from NASA's functional organizations and training officers to validate the content and approach, PPMI/APPL produced PMDP Version 2.0.

Throughout the rest of the 1990's significant changes affecting the NASA project management environment continued to have an impact on the Agency's ability to prepare project managers. Factors such as shrinking budgets, downsizing the civil service workforce, instituting ISO 9000+ quality standards, implementing "faster, better, cheaper" strategic management, responding to GPRA, and establishing new guidelines and policies for program/project management (i.e., NPG 7120.5A), drove efforts to find improved methods to shape project management competencies to meet the changing demands.

In 1999, APPL produced PMDP Version 3.0. This version was developed with significant input from NASA's functional organizations and the Program Management Council Working Group

(PMCWG). It also incorporated processes and requirements established in the newly revised NASA Procedures and Guidelines for program and project management (NPG 7120.5A), and included the results of an assessment of program management knowledge, skills and abilities generated from a focus group of senior NASA program managers using a formal curriculum development method called DACUM. With this revision of the PMDP, APPL fine-tuned a process for preparing program and project managers that was designed to:

- Expand the core competencies and skills of people in projects;
- Advance the implementation of NASA's strategic mission;
- Promote superior project management practices in advance of need;
- Provide a NASA-wide development process for people managing projects;
- Offer clear information about professional development in program/project management; Provide a point of comparison with other organizations' project management approaches; Provide recognition of employee maturity and professionalism;
- Implement with employee-supervisor responsibility (voluntary, Center-managed); and
- Document skills and experiences.

The resulting PMDP Version 3.0 career development model focused on four career levels, reflecting increased responsibilities and performance expectations as employees develop in their careers. Guided by an Individual Development Plan (IDP) and documentation in a Record of Accomplishment (RoA), the individual pursued an individualized process for preparation as a project manager under the guidance and direction of their supervisor or a mentor. In collaboration with APPL, a Center recognized an employee's accomplishment of activities leading to completion of a program/project career level by issuing a *certificate* acknowledging completion. The following career levels were outlined in the PMDP process:

- **Level 1**

Objective: Prepares participants to operate effectively as team members in a project environment

Target Audience: Individuals entering the project environment and operating as a team member

- **Level 2**

Objective: Prepares participant to operate effectively as a subsystem or sub-component team lead operating in a larger system or project environment

Target Audience: Individuals preparing to lead a team of a subsystem or sub-component operating in a larger system or project environment

- **Level 3**

Objective: Prepares participants to operate effectively as a project manager over complex systems

Target Audience: Individuals preparing for a position as a professional project manager over a complex system with multiple components

- **Level 4**

Objective: Prepares participant to operate as a program manager over multiple projects involving complex systems or over a high-visibility agency project

Target Audience: Individuals preparing to manage a program involving multiple projects or a major project

From the start, the PMDP was set up as a voluntary process managed at the Center level. Implementation of the PMDP by Centers was entirely discretionary. Review and validation of Levels 1 and 2 accomplishments was vested in an employee's supervisor or manager. However, a formal Center PMDP Board review and approval was required for approval of Levels 3 and 4. Therefore, an employee could not receive a certificate of accomplishment for Levels 3 or 4 unless a Center established a formal PMDP review board process.

This past year, in response to mission problems and failures that were the subject of the NIAT Report, APPL again completed a thorough review of the PMDP focused on improving the effectiveness of the development process. Although PMDP Version 3.0 provided a good framework for career development of NASA's program and project managers, the "roadmap" for moving along the career path was found to be confusing. Further, while PMDP Version 3.0 outlined actions that NASA's project staff should engage in to build competence in program and project management, including APPL coursework and other on-the-job experiences, it did not provide clear statements of the knowledge, skills and abilities prospective program/project managers must attain in order to be competent to perform at a desired level of management. In addressing redesign requirements, APPL determined that the PMDP must:

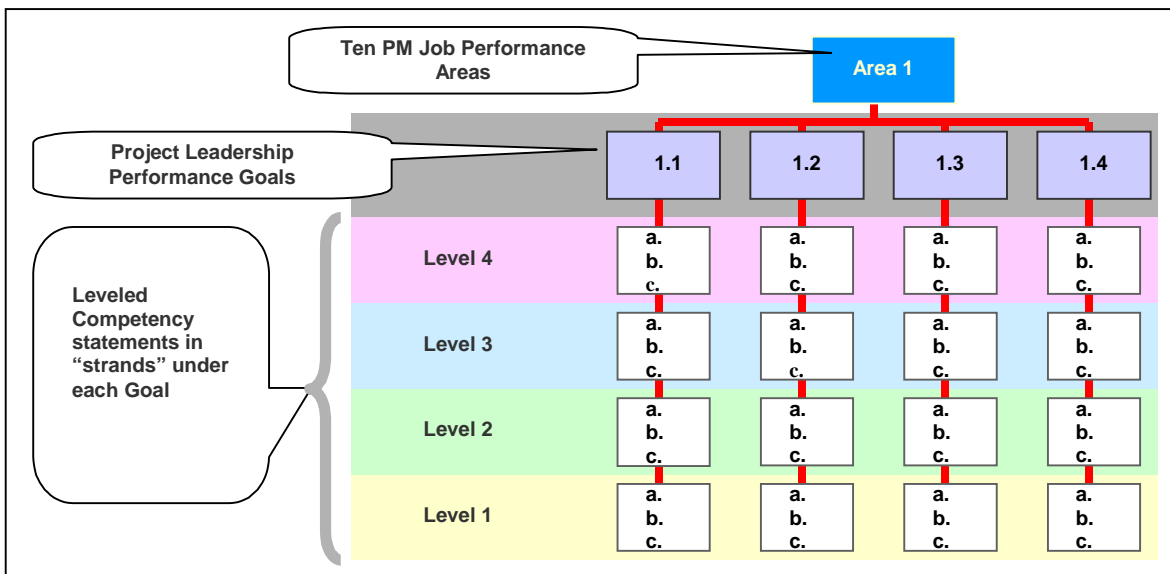
- Be responsive to the changed/changing project management environment of NASA;
- Provide an accurate representation of competencies required for project management at NASA;
- Establish NASA-wide program/project management standards;
- Provide a roadmap for PM development that is easy to follow and understand;
- Be customizable to Center needs and requirements;
- Establish a consistent process for certification; Be adaptable to individual needs and individual differences and lead to an individualized process; Be flexible to implement; and Drive APPL curriculum design and development.

Subsequent to an extensive review and redesign process conducted from January through March 2001, APPL drafted PMDP Version 4.0. For the first time, Version 4.0 detailed a set of specific competencies for all four levels of program/project management performance at NASA. The revised process also included provisions for establishing NASA standards and criteria for attaining competence across all areas and levels of project management development.

PMDP Version 4.0 competency statements were developed from extensive study of the performance requirements and demands of NASA's program and project managers, including input and feedback from some of NASA's most accomplished managers, as well as experts from outside the agency. Like the previous version, Version 4.0 was developed around ten program/project management *job performance areas* under which *project leadership performance goals* were defined. Specific competency statements were developed for the four career levels as *strands* under each performance goal. Figure 1 illustrates the format of the PMDP Version 4.0 approach.

Figure 1: PMDP Version 4.0 Format

A critical feature of the PMDP Version 4.0 is that the process is *performance-based*. All the competencies are linked to knowledge, skills or abilities that are essential to perform effectively as a project leader in the job performance areas. Equally important, the individual determines, in consultation with a supervisor or mentor, an individualized process of coursework, other specific learning experiences and documented performance that will be employed to gain the



competencies required. The ten performance areas of PMDP Version 4.0 are:

1. ***Working in the NASA environment*** to achieve goals and continuously improve
2. ***Managing and developing people*** to inspire enthusiasm and improve performance
3. ***Working with teams*** to foster harmonious effort toward common goals
4. ***Formulating project concepts and plans*** to accomplish mission objectives or technology goals
5. ***Implementing programs and projects*** to produce products and services that meet customer expectations
6. ***Managing risk, safety and IT security*** to balance and reduce threats to project success
7. ***Managing and maintaining resources*** to attain program/project success

8. *Administering and managing acquisition instruments* to ensure timely and cost-effective delivery of specified services and products
9. *Working across organizational boundaries* to facilitate collaboration of diverse interests and cultures
10. *Growing individually and professionally* to become a better program or project leader

Subsequent to revising the PMDP, APPL has begun a thorough review of its program/project management curriculum to ensure that coursework and other learning experiences are aligned with the PMDP competencies. With input from the APPL Curriculum Advisory and Review Team (CART), this review has included a “gap analysis” to determine where the coursework and other learning experiences need to be revised, redesigned, or developed in relationship to the competencies. Additionally, APPL has re-evaluated the course requirements and prerequisites for each PMDP level, and evaluated the IDP process to ensure the revised PMDP Version 4.0 provides a clear and understandable career path for NASA program and project managers.

Last year, APPL also established the PMDP Accelerated Leadership Option (PMDP-ALO) in partnership with the Massachusetts Institute of Technology. The purpose of the PMDP-ALO is to prepare NASA’s “best and brightest” candidates for leadership of NASA’s technical programs/projects. Participants receive a MIT Masters degree in Engineering and Management offered from the System Design and Management program and a certificate in NASA PMDP Level III or IV. This option requires significant distance learning and residency components and is available to all Centers and Headquarters. The content focuses on the practitioner, and provides opportunities to network with professionals from aerospace and other industries. Elements of the program cover safety and risk from a systems perspective, with optional tracks that include information technology and software engineering. The key components of the program focus on system design, product development, business management and leadership, and information technology.

Project managers completing the program may serve as APPL instructors and mentors upon completion of current projects, and receive an assignment with APPL targeted at sharing expertise in terms of project management, functional skills, science and engineering. These PMDP-ALO project leaders will be used to improve the delivery of performance support initiatives across the Agency, focusing on project management, functional, and technical excellence capabilities on the part of the assigned instructors.

NASA’s Project Management Development Process Today

Today, NASA’s PMDP Version 4.0 remains a voluntary process for project personnel. Each Center continues to have discretion to implement the process, and to customize the process to their needs. The NIAT report, however, states that:

NASA will designate the PMDP as the Agency-wide standard for program and project management professional competency and use them as considerations for selection, training, and assessment of key project personnel. The current process will simultaneously be reviewed and upgraded. Centers will analyze and assess the benefits of establishing more Center-specific PMDP competencies that complement and offer more specificity than the Agency-level process.

The NIAT Report also points out that providing development and proactive support to employees is essential to the sustainability of NASA's excellent capability. At the core of this is challenging work that provides opportunities to develop relevant skills, adequate training, and a safe and healthy work environment. The success of NASA depends on having a knowledgeable and skilled workforce, supported by clearly understood processes and methodologies, and armed with tools that leverage emerging technology to simplify and improve design, development, and verification related engineering approaches.

To support the full utilization of the workforce in achieving strategic outcomes, it is established NASA policy to make training and developmental opportunities widely available to employees to enhance individual capabilities, build and retain a skilled and effective workforce, improve organizational performance, and maintain scientific, professional, technical and management proficiency. To this end, PMDP is a central part of NASA's policy to:

- Use on-the-job work experiences as the primary method of developing the job-related knowledge, skills, and abilities of employees;
- Support systematic plans to broaden employees' knowledge and skills through planned, work-related developmental assignments including "on-the-job" training, rotational assignments, and non-NASA work experiences;
- Use formal training and educational experiences to complement work experiences;
- Require program/project managers as well as program/project personnel to have an annual minimum of 40 hours of project management-related learning and strongly encourage them to participate in at least another 40 hours of general learning each year; and
- Support employee training, retraining, and organizational development activities leading to better ways of delivering services, improving work performance, and increasing the value of employee contributions to current and future Agency missions.

PROJECT MANAGEMENT AND CERTIFICATION

In one sense, there is little new or unique about project management. Much that has been achieved in human progress has come by dedicating and organizing human energies and physical resources to meet specific goals...Despite the long history of project management, we still know relatively little about what might be called its human aspects -- what kinds of people fit into a project organization, what effect project assignments have on professional development, how institutions and their employees are affected by the discontinuities that are a necessary concomitant of project management. We still have much to learn about how to make the most of the potential offered by project management while minimizing the side effects.

Homer E. Newell, forward to
Unmanned Space Project Management: Surveyor and Lunar Orbiter (1972)

Since the 1960's companies and organizations that engage in complex tasks and operate in a dynamic environment have increasingly found formal project management to be a mandatory practice (Kerzner, 1998). In many respects, the aerospace and defense industries have been the pioneers in developing techniques and organizational structures for project management, and in defining the project manager's role.

The Project Management Institute (PMI, 1996) defines **project management** as the application of knowledge, skills, tools and techniques to project activities in order to meet or exceed stakeholder needs and expectations from a project. Meeting or exceeding stakeholder needs and expectations invariably involves balancing competing demands among:

- Scope, time, cost, and quality
- Stakeholders with differing needs and expectations
- Identified requirements (needs) and unidentified requirements (expectations)

In the NASA environment, the **project manager** is the person responsible for the successful accomplishment of a project that meets the needs of the customer, including the total range of project activities from supporting formulation of requirements through satisfactory delivery of the final products. Although there are some single project programs in NASA (e.g., Cassini), projects is often part of a larger *program* made up of multiple independent projects. NASA's **program managers**, therefore, provide integrated program planning and execution functions, in addition to their responsibility for successfully accomplishing the program and meeting customer expectations.

To perform effectively, project managers must be able to relate to the people being managed, the task to be done, the tools available, the organizational structure and the organizational environment, including the customer (Kerzner, 1998). Laufer and Hoffman (2000) suggest that

the practice of project management “lies somewhere between a technology and a craft, though it is probably closer to a craft,” and requires both explicit and tacit knowledge.

Aspects of project management that are primarily explicit are those that are expressed in words or numbers, and readily transmitted and shared in forms such as data, scientific formulas, specifications and manuals. Those aspects of project management that are more tacit in nature involve factors such as perceptions, beliefs and values, and include knowledge that is expressed in forms like insights, rules of thumb, intuitions and hunches. While the explicit elements tend to be objective and rational, tacit knowledge is more subjective and experiential. Laufer and Hoffman (2000) indicate that:

While some aspects of project management knowledge are more explicit, a great deal of it, especially in a dynamic, complex, and fast-changing environment, is more tacit.

Project Management Competencies and Certification

The terms *competency*, *standards* and *criteria* are often used in determining the qualifications and requirements for certifying professional groups. Competencies are statements of specific knowledge, skills, abilities, characteristics, attitudes and behaviors that enhance job performance for particular roles within an organization (Lucia and Lepsinger, 1999). A central meaning of a standard is a point of reference against which individuals, organizations, products and processes are compared and evaluated. Additionally, *process standards* provide guidance about the knowledge, tools and techniques that are useful in the practice of the profession (Cabanis, 1999). Standards, therefore, describe the conditions under which the competencies are performed, and the criteria that define the actions or outcomes required for the performance to be considered “to standard” (Hale, 2000).

An effectively designed competency development process includes identifying top performers and determining what they do and how they do it by identifying factors that lead to superior performance. The most useful models are customized for individual divisions and roles within the greater organization (Hale, 2000). Tailoring competency models for organizations can have a variety of scopes, with some models identifying core competencies required for all levels of a workforce, and other models focusing more on developing competencies for a specific unit, type of job or position, such as programmers working in IT.

In industry, organizations that manage the development of capabilities of their managers through competencies gain critical competitive advantage in business processes such as recruiting, retaining, and motivating high-performers (Lucia and Lepsinger, 1999). Competency models address such business needs as clarifying job and work expectations, maximizing productivity, enhancing feedback processes, allowing the organization to adapt to change, and aligning individual and team behaviors with organization strategies and values. Holtzman (1999) points out that, “by establishing proven and accepted standards today, project management professionals can be better prepared for the challenges of the future.”

Lucia and Lepsinger (1999) point out that a natural progression from the development of an accurate and valid competency model is to assess employees according to the requisite competencies for their specific job position, and provide tools to develop professional

capabilities based on employee assessments. Hale (2000) differentiates three models for developing and assessing competency:

- **Knowledge-based:** Knows the terms, rules, principles, concepts and procedures, and demonstrates this knowledge in a testing situation.
- **Skill-based:** Can apply the terms, rules, principles, concepts and procedures under controlled conditions, such as simulations.
- **Performance-based:** Can apply the terms, rules, principles, concepts and procedures consistently under real working conditions.

A competency-based framework is the backbone of an effective project manager development and certification program (Crawford, 1999). In developing competencies for project managers the application of external project management standards must be placed into an organization's specific context if the potential benefits of assessment, certification, and ongoing development are to be realized. Crawford (1999) makes the case that assessment links learning outcomes with learning objectives in a meaningful way. She identifies several standards against which assessment can be made, including the PMBOK, the International Project Management Association (IPMA) Competence Baseline, and the Australian National Competency Standards for Project Management. Crawford notes, however, that there are several problems with these external standards of certification, such as:

- They tend to be based on a static interpretation of the past, neglecting continuing professional development;
- The standards tend to be generic and do not capture the complexities and variations of specific project environments; and
- Personality and attitude components may be de-emphasized or neglected.

Table 1 provides a comparison of the areas of emphasis for three project management competency models. The first column represents nine project management *knowledge areas* outlined in the PMI's (1996) *Project Management Body of Knowledge* (PMBOK). The PMBOK refers to the content of these areas as "generally accepted" knowledge and practices that are applicable to most projects most of the time, and that there is widespread consensus about their value and usefulness. PMI offers a Project Management Professional (PMP) certification that is based principally on the knowledge contained in the PMBOK. To achieve PMP certification, each candidate must satisfy all educational and experiential requirements established by PMI and must demonstrate an acceptable and valid level of understanding and knowledge about project management that is tested by the Project Management Professional Certification Examination. In addition, those who have been granted the PMP credential (certificants) must demonstrate ongoing professional commitment to the field of project management by satisfying Professional Development Program requirements.

The middle column lists ten project management *skill areas* presented in Kerzner's (1998) text on *Project Management: A Systems Approach to Planning, Scheduling, and Controlling*. The content of these areas include specific skills required to perform effectively in these areas, and the personal management traits underlying these skills "that operate to form a homogeneous management style." Although Kerzner's skill areas are not linked to a specific certification process, the connection he makes between knowledge and management styles and personal traits

suggests that evidence of proficiency and mastery of these skills goes beyond tests of knowledge alone.

The final column provides the ten project management *job performance areas* from PMDP Version 4.0 that have been customized, or “contextualized,” to NASA’s unique project management environment and performance demands. Within the PMDP each area is broken down into *project leadership performance goals*, with specific competency statements developed, by career “level,” in *strands* under each goal. The PMDP also provides performance standards and criteria for each competency to guide an individualized process for achieving, demonstrating and documenting the required knowledge, skills and abilities. NASA’s PMDP competency model is also performance-based, and requires each participant to design an individualized development process that specifies the learning experiences and activities they will be used to attain competence and the means they will use to demonstrate and document performance.

Table 1 Comparison of Competency Areas for Three Project Manager Competency-based Models		
PMBOK (1996)	Kerzner (1998)	NASA PMDP v 4.0 (2001)
PM Knowledge Areas:	PM Skill Areas:	PM Job Performance Areas:
Project Integration Management	Team Building	Working in the NASA Environment
Project Scope Management	Leadership	Managing and Developing People
Project Time Management	Conflict Resolution	Working with Teams
Project Cost Management	Technical Expertise	Formulating Project Concepts and Plans
Project Quality Management	Planning	Implementing and Evaluating Programs and Projects
Project Human Resource Management	Organization	Managing Risk, Safety and IT Security
Project Communications Management	Entrepreneurship	Managing and Maintaining Resources
Project Risk Management	Administration	Administering and Managing Acquisition Instruments
Project Procurement Management	Management Support	Working Across Organizational Boundaries
	Resource Allocation	Growing Individually and Professionally

Developing a Performance-Based Certification Program

A recent project management baseline study conducted by Interthink Consulting, Inc. (Mullaly, 2001) identified a number of key factors that are representative of organizations that are highly successful in managing projects throughout the project lifecycle. These factors include a formally established project management career path, an integrated curriculum and training program that supports the organization's processes and career development strategies, and a system that recognizes and rewards professional accreditation and advancement.

Hale (2000) points out that an organization considering a performance-based certification program should first develop a justification for the expenditure of resources (both money and people) to create and deploy such a program. Because certification programs often are established as a result of some specific problem, knowledge of the initial and long-term investments required to implement the certification program is also important so the cost of certification can be compared with the cost of alternative solutions to the problem. In making a case for certification, Hale points out that the question to be answered should *not* be framed as “Should people be qualified to do the job?” Rather, questions that drive the decision-making process are more informative if they address issues such as:

- Is certification the best way to make sure people are qualified or can perform to the same standard anywhere in the world?
- Is certification the best way to confirm that people are performing to standard consistently?
- Is certification the best strategy for accomplishing our goals?

A well-designed certification program identifies and describes who is to be certified by the program, the business needs that are driving the program, and the associated stakeholders. Hale (2000) has identified seven key elements that should be defined and developed for any certification program:

- *Certification requirements*: what people must do to become certified;
- *Program standards*: the program’s assessment criteria, derived from job or task analyses and from inputs from key stakeholders;
- *Program tests*: the assessment methods that will be used to determine whether candidates have met the program standards, and how those methods will be created, administered, maintained and evaluated;
- *Preparation and remediation options*: the opportunities for training, education, apprenticeships, on-the-job experience, and other experiences that will be provided to help candidates meet the program’s standards and fulfill requirements;
- *Governance body*: the group of individuals, such as a board of directors, that will provide oversight and stewardship, set policy on issues like appeals, re-certification, grandfathering and information disclosures, and evaluate the program’s effectiveness;
- *Administrative practices*: how the program’s assessment, record-keeping and reporting processes will be administered to eliminate bias, preserve confidentiality, and prevent misuse of test results; and
- *Public relations and communications plan*: how information about the purpose, operating specifics, results and impact of the certification program will be disseminated to management, customers, employees and suppliers.

Figure 2 details an approach for establishing a performance-based program and project manager certification process that was adapted from Hale (2000). As the figure illustrates, there are four phases involved in establishing a certification program:

- Laying the groundwork
- Designing the program

- Developing the elements
- Implementing and evaluating the program

When compared with the process outlined in Figure 2, NASA currently is well along the path to have a formal certification program for program and project managers. Much of the groundwork for a NASA program/project manager certification process has been laid down in the NIAT Report. For example, the report indicates that:

Certification represents a more stringent and rigid application of professional development standards by requiring formal compliance of standards before an individual could be selected for a position. NASA recognizes both potential benefits and problems with certification...Options for addressing the issue of certification will be analyzed and submitted to the NASA Chief Engineer for consideration. A decision on whether or not to establish certification will be made based on Senior Management Council review of the findings and recommendations.

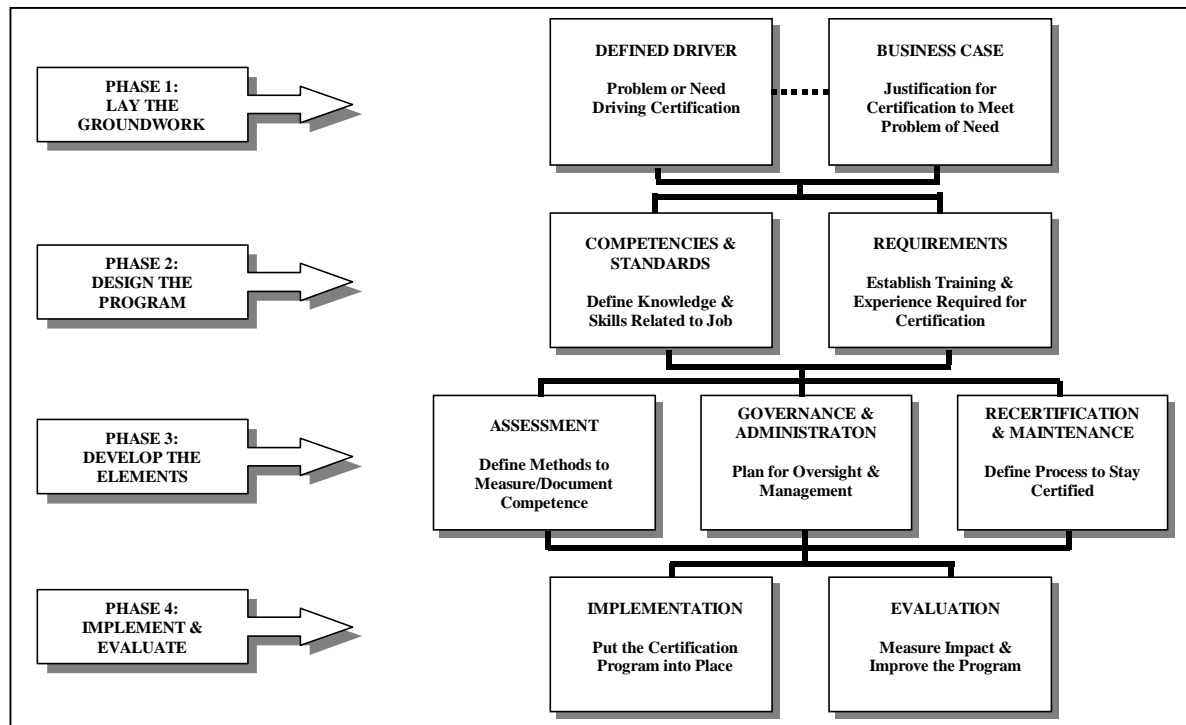


Figure 2: Approach to Establishing a NASA PM Certification Program

The redesigned PMDP Version 4.0 now provides the competencies, standards and requirements that can form the basis for a formal NASA project manage certification program. APPL also has in place an established curriculum that provides the training and directs other learning experiences necessary to attain the competencies. Therefore, if NASA chooses to proceed with a formal certification program, the process could begin at Phase 3.

The results and recommendations of the benchmarking study reported in the next chapter are remarkably consistent with expert views in this chapter. Study respondents emphasize that the

decision to go ahead with a formal certification program based on a set of specific competencies for a large, complex organization like NASA, IBM or Motorola is a major, serious decision in the history and culture of the organization. For certification to be successfully implemented and achieve the desired results, corporate or agency leadership must be ready to invest substantial time and money and lead a process of culture change. Substantial resistance must be expected, and leaders should have clearly in mind both the agency problem that formal certification will solve and how certification is likely to change the agency and its culture.

It may be that the purpose of project management, which is to release greater human and organizational potential by escaping from the rote rules and deadening routines of bureaucratic management, would be undercut by instituting more rules and general requirements for certification of project managers before they could function as project managers. Certification rules and practices may give assurance that all project managers in NASA at specific levels possess comparable qualifications, but some persons with leadership potential may find a formal certification process too constricting. Further, Downs (1967) reminds us that as bureaus and their leaders age, they will be tempted to institute rules for the sake of agency and career security:

As bureaus grow older they tend to develop more formalized rule systems covering more and more of the possible situations they are likely to encounter. The passage of time exposes the bureau to a wide variety of situations, and it learns how to deal with most of them more effectively than it did in its youth. The desire for organizational memory of this experience causes the bureau's officials to develop more and more elaborate rules. These rules have three main effects. First, they markedly improve the performance of the bureau regarding situations previously encountered, and make the behavior of each of its parts both more stable and more predictable to its other parts. Second, they tend to divert the attention of officials from achieving the social functions of the bureau to conforming to its rules --- the 'goal displacement' described by sociologists. Third, they increase the bureau's structural complexity, which in turn strengthens its inertia because of greater sunk costs in current procedures. The resulting resistance to change further reduces the bureau's ability to adjust to new circumstances. Consequently, older bureaus tend to be more stable and less flexible than young ones.

In interpreting the results and recommendations of the benchmarking study, attention should be paid to whether formal, universal, prior certification for project managers sacrifices too much of NASA's potential for change and adaptation to fast-changing circumstances in favor of perceived agency security. Would the problems created by certification be more or less serious than the existing problems meant to be solved by certification?

BENCHMARKING STUDY

In a still larger sense, Apollo 11 demonstrated that with determination, time, and resources complex national goals could be achieved. "If we can put men on the moon, we can..."; or, "Why can't we...?" – although an oversimplification – became a benchmark for measuring progress, or a lack of it.

Cited in the Epilogue to: *Chariots for Apollo: A History of Manned Lunar Spacecraft*

Courtney G Brooks, James M. Grimwood and Loyd S. Swenson (1979)

As part of an evaluation of a NASA certification process for program and project managers the NIAT Report called for a *benchmark study* with industry and Government organizations to assess their approaches to and experiences with program/project manager certification. The results of the benchmark study would be used to determine the current state of the practice of certifying project managers within Government and industry, and outline advantages as well as disadvantages of certification that can be used to determine the advisability of implementing a NASA certification process.

Method

Two Federal Government agencies and five private sector companies that currently have or are considering implementing a program/project management certification processes were contacted and agreed to participate in the benchmarking study. The participating agencies will be named in this report, but the private corporations will remain anonymous to prevent any issues of unfair competitive advantage. The public agencies were the Department of Defense (DoD) and the General Services Administration (GSA). The private corporations were selected from various industries, to include high tech, insurance, and construction engineering services.

Each participating agency/company was studied between January and March 2001 using two different qualitative methods. First, a *structured interview* was conducted with personnel identified as the certification “process owners” within the agency or company, that is the person(s) responsible for project management development within the organization. Second, when available, a *focus group* of representative program/project managers selected by each organization’s process owners was interviewed to identify project management career development and certification practices, processes and experiences across different levels of the organization.

The interviews and focus groups were conducted using a set of questions developed in consultation with internal NASA stakeholders. These questions were designed to guide the structured interview process and direct the discussion of focus group members. In some cases telephone interviews were conducted where travel and scheduling did not allow for face-to-face meetings. Telephone and face-to-face interviews and focus group discussions followed the same format in order to ensure consistency of the process and comparison of results.

The following questions were used in the formal interviews and focus group discussions:

1. Describe the organizational project management development and certification process, to include consideration of the following topics:
 - a. Brief history of process development and implementation, to include partnerships
 - b. Structure/levels of the process
 - c. Functional/ knowledge areas
 - d. Eligibility requirements, competency requirements, standards at each level

- e. Training requirements
 - f. General education requirements
 - g. Developmental experience requirements
 - h. Typical paths of project management careers (for Federal partners, interest in creating a designated project manager job series)
 - i. Certification procedures
 - j. Technologies that support project management content and business processes
2. How is the project management development and certification process integrated into other business processes within the organization, such as:
 - a. Recruiting (announcement and selection)
 - b. Retention
 - c. Skills and career development
 - d. Rewards and incentives
 - e. Performance metrics
 3. What are the benefits of developing and certifying project managers for the organization, and what are the metrics, in terms of:
 - a. Human resources, career development, and organizational culture (achieving input and buy-in at all organizational levels)
 - b. Business practices
 - c. Business strategy
 - d. Gains in efficiency and effectiveness
 - e. Bottom-line accomplishment of project goals
 4. What are the problems that project management development and certification presents to the organization in terms of:
 - a. Human resources, career development, and organizational culture (achieving input and buy-in at all organizational levels)
 - b. Business practices
 - c. Business strategy
 - d. Gains in efficiency and effectiveness
 - e. Bottom-line accomplishment of project goals
 5. What would the organization do differently in developing and certifying project managers in light of the history of the process to this point?
 6. What would the organization recommend to NASA in considering the development and implementation of a project management development and certification process?

Results: Descriptions of Project Management Training and Certification Processes

Responses to the study questions were compiled and analyzed for each organization. The responses were then organized into descriptions of project management training and certification processes, including perceived benefits of developing and certifying project managers, and problems that project management certification presents to the organization.

Federal Government Agencies

- Department of Defense (DoD):
 - Naval Facilities Command (NAVFAC)
 - U.S. Army Corps of Engineers (USACE)

The Department of Defense's (DoD) Acquisition Personnel Development system was originally driven by a need to educate and train defense systems acquisition personnel. Previous failures in defense systems acquisitions had convinced Congress that legislation was needed to improve the effectiveness of the military and civilian acquisition workforce through a formalized set of training and career development requirements.

In 1971, the Defense Systems Management College (DSMC) was established to “promote and support the adoption and practice of sound systems management principles by the acquisition workforce.” DSMC is now part of the Defense Acquisition University (DAU) that was established in 1992. DAU is comprised of several Department of Defense (DoD) education and training institutions and organizations. Through its member institutions, DAU provides acquisition education and training and fosters acquisition policy research. The campuses provide training for acquisition professionals in all acquisition career fields. Each educational institution provides acquisition courses that encompass basic, intermediate, and advanced acquisition curricula. DSMC plans, schedules and conducts program management courses and provides executive level continuing education to support the acquisition management workforce. DSMC's courses include a mandatory core course for Level III acquisition professionals, post core courses designed to improve the effectiveness of the newly assigned program managers who have completed the core course program, assignment-specific international acquisition courses, and executive courses.

Certification is a process by which DoD component organizations determine that employees have met the minimum standards established for training, education, and experience in the DoD acquisition career model. The Defense Acquisition Workforce Improvement Act (DAWIA) requires that the DoD and the Services establish formal acquisition career paths and career development activities for military and civilian personnel. This is implemented through 11 career fields and 15 acquisition position categories, covering the entire range of acquisition-related jobs such as Information Technology (IT), finance, contracts, logistics, and testing and evaluation.

The DAU has specified certification standards for acquisition positions that draw from the pool of personnel from the 11 acquisition career fields and 15 acquisition position categories. The certification process serves a diversified workforce of approximately 135,000 personnel, with approximately 9000 serving in the project management career field. Specific qualifications in education, experience, and training for each acquisition position category are defined for three career levels of basic or entry (GS-5 through GS-8), intermediate or journeyman (GS-9 through GS-12), and advanced or senior (GS-13 and above). Supervisors and employees prepare a standardized Individual Development Plan for Level 1 and Level 2 employees to outline how mandatory and desired certification standards will be met.

Grandfathering is not permitted, but equivalencies are granted based on previous experience, education, and alternative training that is successfully completed and documented in accordance with course competency standards and specific procedures of the DAU and by the procedures of the particular component organization. Exceptions are defined and approved according to the component organizations, and their processes for certification vary according to the needs of the particular component.

The DAU curriculum is extensive, and covers desired and mandatory elements defined by each career field for its employees. Fundamentals courses are required for everyone and consist of approximately 20 weeks of resident training. There are also extensive selections available in the areas of auditing, business and financial management, contracting, property administration, information systems, logistics, program management, quality, system engineering, and testing. Currently, there is an initiative in transferring basic and intermediate courses to the Web, allowing for a combination of mandatory resident and Web-based courses to fulfill certification requirements. In terms of continuing education, there is a mandatory requirement of 40 hours annually.

This process is tightly integrated with organizational business processes, and the Individual Development Plans (IDP) supplement the required annual performance reviews. Personnel records establish certification as a criterion for selection of assignments and promotion.

Naval Facilities Command (NAVFAC) and the U.S. Army Corps of Engineers (USACE) currently do not possess an organization-wide project manager development and certification program. NAVFAC has approved adoption of the DoD development and certification program, while USACE is currently conducting a benchmarking activity in order to identify best practices in terms of project manager development and certification. There are several stand-alone efforts within USACE that attempt to develop project managers, but the headquarters desires an integrated and comprehensive approach.

- **General Services Administration (GSA)**

Project management has been identified as the primary way that the General Services Administration (GSA) conducts business, and the organization started to look seriously at developing and certifying their project managers approximately 10-15 years ago. The

organization, like other Federal agencies, has progressed through different approaches depending on governmental and business imperatives.

GSA's current approach centers on the two main populations of design and construction project management and the related support elements. At the present time, GSA does not possess a multi-level competency framework, but is working towards a defined model. Current desired skills and traits for project managers have been developed by the GSA Project Management Center of Expertise, and cover the following areas:

- Business Skills such as negotiation, project cost management, and project management skills
- Communication Skills such as written, oral, and conflict management
- Influence Skills such as teaming and change management
- Managerial Skills such as project coordination and political awareness
- Problem-solving Skills such as analyzing and assessing
- Technical Skills such as serving as a PM for one or more prospectus-level projects within the last 10 years and understanding the entire construction process
- Traits such as Agreeableness, Assertiveness, Confidence, Conscientiousness, Judgment, and Trustworthiness.

The majority of project management courses are outsourced, and each department maintains a list of training vendors that meet the requirements of the organization in terms of project management development. Other developmental activities are offered by the Human Resources department through the University for People, covering basic-level project management. The Central Office identifies organization-wide business imperatives and contracts for activities such as Sustainable Design, a required activity for all GSA project managers. Web-based programs are currently generic, but there is a desire to develop and organize project management tools and techniques that can be accessed by personal computer. GSA is currently attempting to develop a project management template that will integrate the existing tools and databases in GSA.

GSA looked at PMI Certification, but found that the majority of employees did not like the content of the program and that the certification process tested knowledge, not capability. They are now looking at other programs that are more construction-specific, but will continue to view external programs as part of a comprehensive PM developmental approach. GSA will continue to sponsor and pay for a corporate membership with PMI for all of their project managers. Additionally, the organization is concerned about the training and development of their contractors, and views external certification as a possible discriminator in contract performance, though this is not a formal requirement.

In terms of integration with Human Resources, Individual Development Plans (IDPs) for project managers are used by the organization to identify gaps in capability and develop a training plan. The IDPs are tied into the biennial performance reviews that cover the following elements:

- Budget

- Schedule
- Customer Satisfaction
- Management

Rewards and incentives are controlled at the department level by the payment of bonuses through the achievement of performance-based targets in terms of project scope, schedule, and budget. GSA has developed a voluntary grass-roots developmental activity that they call the Project Management Guild that focuses on bringing together project managers, architects, and engineers from internally and across the Federal government in order to identify and develop best practices and promote employee development and recruitment. The program is very successful and the organization wants to formalize the process. The Guild is sponsored by executive management and is managed by a cross-functional steering team. In order to promote Guild activities, a budget for this activity is provided to each of major project department by senior management. The Guild is organized as follows:

- Technical Task Force, responsible for meetings, seminars and training sessions.
- Training and Development Task Force, responsible for recommending training criteria, developing mentorship, sponsoring and implementing New Employee Orientations, developing the co-op program, and developing the Intern program.
- Human Resources Task Force, responsible for recommending basic qualifications, developing standard criteria for Knowledge, Skills, and Abilities (KSAs), participating in workload analysis and resourcing strategies, reviewing and standardizing Position Descriptions and Job Analyses and crediting plans, developing Interview Guides, and recruiting and training Guild members for evaluation and interview panels.
- Communications and Professional Liaison Task Force, responsible for working with IT personnel to maintain the Guild Website and increasing Guild membership participation in professional associations.

GSA has a process in place that formally assigns junior project managers to senior project managers, but there is no evaluation of the effectiveness of the program. The concept is valued, however, as a necessary component of their PM development and certification program.

Private Industry

- **Company 1**

Company 1 is a private, family-owned engineering and construction company that provides support in at all phases of projects, ranging in activity from the conceptual phase through designing, building, operating, and dismantling. In the late 1960s, Company 1 introduced project management as a better way to conduct business, “instead of having a

design manager tossing a work package over the fence to the construction side of the house.” The organization found it to be a difficult transition, where designers and engineers did not want to give up their responsibilities without a fight.

Today, Company 1 uses project management to pursue new business areas, such as the operation of industrial plants. The organization is organized as a matrix, with functional areas (such as engineering, procurement, safety, contracts, project operations, etc.) responsible as “keepers of the knowledge” for each of their particular disciplines. The matrix format provides a stable organization that keeps project managers up to speed in their particular area. Human Resources provides general organizational training, but the specific disciplinary training design rests with each functional area. When a project comes in, a project team is staffed from the functional organizations, collocating the basic team and assigning personnel as required, with the team ebbing and flowing according to the lifecycle status of the project. A Corporate PM committee looks after the welfare of organizational PMs and their assignments in projects that range from six months to seven years and longer.

To qualify for selection and development as a PM, the majority comes from internal recruitment with an average of five to seven years with the company, and approximately 30-40 percent coming from external recruitment efforts. Performance and a successful record of accomplishment are key qualifications, along with demonstrated leadership traits.

Company 1’s PM training program is a three-tier model consisting of:

- Tier 1 is a basic level program lasting five days that orients PMs and support personnel to the overall organization and operations. The program is competency-based, covering the basics in contracting, procurement, and other topics. It is a resident course offering valuable opportunities for networking between the 25-30 personnel per course. The course is offered four times per year in San Francisco.
- Tier 2 is a middle level program that emphasizes hands-on experience and additional PM tools and techniques. This part of the program is currently under development, with the majority of content placed on the Web. An internal PM simulation is being considered, with mandatory certification at this level for all PMs.
- Tier 3 is a program that emphasizes management of project portfolios and strategic considerations.

Direct outcomes from training are not measured, but there is an intuitive confidence demonstrated by managers based on a current average of nine on a ten-point scale. Courses are also taught by the functional managers and paid for by the functional managers out of their budget for support personnel, with project operations paying for the training of PMs. Their managers have identified all attendees as excellent performers. In terms of capturing experience, Company 1 uses resume’ files and an internal skills assessment tool, but relies heavily on the knowledge of personnel by the operations managers.

There is a requirement for all outside people to go through tier one, regardless of experience, with no grandfathering allowed due to dilution of the organizational culture. A separate component to the training program is the PM career path that contains responsibilities at each level, job descriptions, and the corporate PM career path. This element is closely coordinated closely with HR, consisting of a defined PM career path, desirable positions for development at each level, and job descriptions for each level. The PM population is approximately 500-600 personnel, with the majority possessing a BS in Engineering and an MBA. Potential PMs may be assigned as deputies on real-world projects, so that real-world learning occurs in a performance-based environment.

External certification is not required, but is supported if pursued, particularly with PMI. Internal certification will be required at tier two eventually. The organization now has a tracking mechanism for training and development, and is now mature enough to track learning and experience in a centralized database. In terms of training metrics, pre-tests and post-tests are given for courses.

The training and career development programs are tied into HR. Yearly performance reviews are tied to individual development plans, and attendance at training that addresses identified capability gaps requires supervisor approval. Individuals indicating an interest and capability for project management are referred to the project operations area, and this effort is coordinated with functional management as well as with HR, who is tasked with identifying, developing and retaining excellent people across the entire organization. Additionally, a program called *People Days* allows senior managers to highlight their important people, who are then looked at in a special book as candidates for PM positions.

Company 1 uses a three-element model in ensuring project success:

- Providing standard organizational tools and processes for PMs
- Effective and efficient training for PMs
- Implementation of Readiness Reviews and Management Assessments, jointly sponsored by the project operations and quality control areas, where functional managers travel with operations managers to visit a project as a team over a two to three day review of a project. The review checks on the use of tools, the project team accomplishing what they signed up to do, and to collect and share best practices. This element acts as a forcing function in some ways and occurs two to three months after award, and usually once or twice a year.

In terms of new tools and techniques, several are being developed internally, to include a Project Portal, a Project Knowledge Matrix, Project Team Workbooks, and checklists for project lifecycles of smaller projects that typically have less experienced personnel. Enterprise tools are also employed, such as Primavera for schedules, Expedition for subcontracting, and an internal PM tool for contracting. The preference is to use commercial products as much as possible, since internal tools require a high level of maintenance.

Retention of PMs is based on flexibility and mobility, with standard relocation policies that outline how and when PMs will be assigned and reassigned. A capable and mobile person is the most valuable asset for the company. The organization also tries to implement standard tools and practices across all projects so that individuals going from one project to another has an easier transition. Rewards and incentives include promotions, annual bonuses, assignments, and merit increases. The bottom line in retention and rewards is performance over all other criteria, in terms of safety, cost, schedule, customer satisfaction, and meeting specifications.

- **Company 2**

Company 2 began their PM development process in 1990 as a Global Services initiative for software developers, and followed the DOD model in initially establishing the minimum criteria. The company soon realized that they needed common processes across the organization in order to handle expanding the business and training new personnel to requirements. The entire organization formally committed corporate investment to project management development and formal certification in 1996, with executive level champions for services and products serving on the PM Center of Excellence Steering Committee, hundreds of hours spent with organizational teams, and quarterly progress reports up to the Chief Executive Officer level.

There was a two-year phase-in period where grandfathering was not permitted, but equivalencies, self-assessments, and condensed fast-track curriculums for experienced project managers were made available. The PMI examination was mandatory in this transition period. Grandfathering was viewed as defeating the purpose of mandatory certification, and there were many complaints during this transition period.

Company 2 has identified project management as the way that work is conducted within the entire organization. Company 2 realized that it takes more time to do things from a project management perspective. Managers usually “shoot from the hip” and make mistakes before moving to a formalized project management process. It has taken the organization 10 years to fully come to the realization that project management is a better paradigm than gut feeling and intuition.

The model is currently a mandatory PM certification process backed by a corporate PM competency model defining expected capabilities at each PM level, and functional area professional requirements identified and integrated for particular communities such as IT and finance. They have a five-tier PM career system that formally certifies project managers at the top three levels, with project management viewed as a fulltime career field with clearly defined career paths and specified minimal levels of education and experience at each level. Career paths for PMs has always been in place for Company 2, but the organization has moved from 57 different project management jobs down to five, making the promotion path much clearer and emphasizing that project management is not simply an administrative function anymore.

In this system, managers determine whether they want to track a person as a PM. However, there are still some problems in convincing the manufacturing and development divisions in their perception of giving up their engineering stripes. Project

support personnel are fitted in under the rubric of Integrated Product Teams (IPTs). This framework is imposed as a series of checkpoints and life cycle elements that are employed for cross-functional teams under a Product Development Team Leader that is not under the rule of mandatory certification yet.

To be certified, PMs must defend how and where they achieved their capability and defend their level of performance through documentation of three project profiles in a standard format at the third level, and four project profiles at each of the next two levels. There are a mandatory 29 days of prescribed resident tier one education that is designed to drive consistency in knowledge and behavior across the organization, with the tier one curriculum bringing personnel together and increasing at the advanced levels. In addition, there is a minimum yearly lifelong learning requirement and a mandatory re-certification every three years through standard project reports. PMI certification is required as an input for the third level, paid for by Company 2.

The PM development and certification process is closely tied into other business processes in terms of an integrated approach of people, tools, and methods. It crosscuts management processes and is ingrained in all business and technical processes. Several personnel commented on the huge challenge of having to look at diverse company processes to define the fit with PM development and certification. There is a strong integration with Human Resources (HR), resulting in clear job descriptions, improved recruiting, improved retention, and clearer specific job family assignments for PMs. There is a voluntary tie-in of the PM process to performance appraisals, but it is clear that certification is required for promotion within this organization. The PM records are maintained in a central corporate database, signed off by supervisors and reviewed by a certification board of peers drawn from eight different specialty areas, i.e. hardware development, software development, strategic business process. Each certification board possesses a business process focus, and board members can nominate members, or executive management can nominate members depending on business imperatives. Some company divisions view the PM development and certification process as promotion review board, although that is not how it is intended. Incentives were pulled out of the process once it became mandatory as a condition of employment. It began in a prescriptive fashion simply to move 13,000 people in one direction.

- **Company 3**

Company 3 has developed a project management development and certification process that began in 1993, when Project Management was identified as a company key core competency. The organization formalized PM as a profession with clear career paths, comprehensive position descriptions, and job aids such as a PM Guide were established to help the employee's transition to the new career field. Minimum qualifications were established as criteria to enter the PM profession, and standards were set to define how personnel would be considered qualified, certified, and re-certified.

The PM development and certification program was standardized throughout participating Divisions and Companies within Company 3, and each organization defined their Project Manager roles and responsibilities along with their particular Project Management career path. In order to emphasize the program and ensure integration into

other business processes, a Project Management Executive Steering Committee was created to oversee the process and to grant certification and re-certification approvals, with similar steering committees created at each Division or Company.

The PM development and certification program follows a specific cycle in order for employees to achieve two separate but related elements of the program: qualification and certification. For qualification as a PM, an official application is completed and forwarded to management for review and approval. A Company PM Steering Committee then reviews and approves the application, which then is forwarded back to the employee, marking the employee as qualified for PM development and certification. At this point, the employee completes a self-assessment process and reviews gaps in PM capability with management. A development plan is created so that the employee can now move towards certification as a PM through approved development activities over a period of time.

The certification cycle begins with completion of an official application that is forwarded for management review and approval. The approved application is then forwarded to the Company PM Steering Committee for review and recommendation for approval. The application is forwarded to the President of the Division or Company for review and approval, and then sent to the PM Executive Steering Committee for review and approval. Once approved, the application returns to the employee, and a self-assessment is created so that management can review the next steps for continuous improvement of capability for the newly certified project manager. The self-assessment instrument consists of:

- Eleven Major Categories assessed (e.g. quality/process, PM, technical skill, risk, proposal, etc.)
- Thirty-one Sub-Categories (e.g. leadership, planning, organizing, preparation, strategy, relationship, etc.)
- One hundred fifty-seven specific components and skills (e.g. vision, empowerment, communication, analysis, assessment, metrics, etc.)

Each of these assessments is based on particular skill competency levels that are defined as:

- Level 1 - Entry and qualification
- Level 2 - Basic knowledge and awareness
- Level 3 - Ability to perform with assistance
- Level 4 - Ability to perform without assistance
- Level 5 - Ability to advise and lead others

In terms of training and education requirements, there are specified training courses that are required to be considered qualified or certified. The following are one-time resident training courses:

- Project Management
- Subcontract Project Management

- New Manager Leadership
- Systems Engineering

For certification, an experience equivalency may be acceptable in lieu of certain classroom training, but employees will not be grandfathered into the program. These equivalencies are made at the discretion of the Steering Committees, and non-company specific training may be acceptable in lieu of company training if strong the employee makes justification. Key external PM training and certification programs may be substituted for the self-assessment requirement and certain elective training when applying for certification. These substitutions include PMI Project Management Certification and the DoD Defense Systems Management College (DSMC) Advanced Project Management Course resulting in a DoD Level III Certification. The experience summary is used for Steering Committee reviews and follows a standard format. The Committee is looking for a minimum of three years of project management experience, and the employee is expected to cover all related experience (industry and military), to include project name, type, value, responsibilities, challenges, and successes. This summary is required regardless of a DoD Level III or PMI certification.

- **Company 4**

Company 4 initiated development of the Project Management Professional Development Program approximately five years ago under the auspices of their corporate university. Poor project performance, lack of knowledge and skills of Project Managers, and costly production delays led to the development of the program as a strategic imperative, thus enjoying the support of senior management. A needs analysis identified that very few of the organization's project managers had attended specific PM-related training. Company 4 is a product-oriented company, servicing clients in the government and private sectors with products and services from the areas of computer technology; semiconductors; and corporate services to include research and development labs and communications products and services.

Company 4 currently collaborates with ESI International to develop and implement the development and certification process. ESI develops and manages programs and courses specifically related to project management. As part of the relationship, George Washington University approves course content and awards course completion certificates as well as a Master's Certificate in Project Management. In addition, the Project Management Institute (PMI) administers the Project Management Professional (PMP) examination for Company 4 personnel, and certifies project managers who pass the examination and meet the qualifications.

The company piloted Risk Management training in 1996 and the PM curriculum in 1997. The peak year of number of training days worldwide was in 1998 with approximately 65,000 - 68,000. In addition to resident offerings, the organization offers web-based and CD-ROM-based training for distance-learning students. For project support personnel, there is an available two-day interactive workshop and Team Training workshops. All of the courses are open to all employees, even those not planning to pursue professional credentials.

The organization defines five levels of Project Management for their organization in terms of competency and desired capability. Each level must meet the PM competency requirements identified for their level, defined as customer/market relationship, manageable risk/impact (encompassing technical risk, schedule risk, market risk, etc., where the impact is market value against dollar value, strategic value, etc.), defined span of influence, and experience, education, and knowledge (ranging from a minimum of a BS/BA Degree, four to seven years experience, and training defined as six credit hours of PM courses at Level 1 to 20+ years experience, 10+ as PM, and six additional credit hours of PM courses at Level 5). Abilities, skills, knowledge, experience, and defined characteristics increase with each level of competency. The levels are:

- Level 5 - Vice President, Projects
- Level 4 - Director, Projects
- Level 3 – Principal Project Manager
- Level 2 - Senior Project Manager
- Level 1 - Project Manager Level

Company 4 has defined nine project management competencies in their model. The competencies are:

- Building customer relationships and stakeholder expectations
- Leadership
- Project management tools and information technology
- Monitor project performance
- Business acumen
- Management skills
- Project execution
- Project management knowledge
- Project planning

In addition, the organization has identified 12 management competencies that are not specific to PM, but fundamental to effective management, and increase as the project manager climbs the career ladder. These general management competencies are:

- Communications
- Creativity
- Decision-making
- Flexibility
- Influence and persuasion
- Initiative
- Loyalty

- Negotiation
- Relationship
- Change management
- Integrity
- Strategic Thinking

The company offers four options for earning PM credentials in partnership with ESI and PMI:

- Master's certificate in PM
- Master's certificate in Technology
- PM Master's certificate with a Specialty in Global Business Management
- Certification as a PMP by PMI, where Company 4 offers formal training to pass PMP test (PMI has certified 850-900 employees since 1995 for the organization).

The development and certification process has been integrated closely with the business imperatives. Originally, their corporate university had difficulty finding a corporate sponsor, but found the Corporate Vice President for Engineering to agree to sponsor the PM initiative. From this, a Corporate Engineering and Project Management Council was established to serve as a Business Review Board to establish disciplines, funnel selection of project managers, sort requests for participation in program, create screening criteria, and advise on curriculum.

Company 4 recruits Project Managers from inside the organization, only occasionally recruiting externally. A predictive assessment tool used by NASA to select astronaut teams is used in PM workshops to identify and select PM recruits, creating a personal and communications profile that identifies if a person would do well as a PM.

In terms of technology, they include a Portfolio PM Tool, an Interface Management Tool, and "Dante," a collection and database tool that collects and maintains core project information. For project support personnel and projects that need assistance, Company 4 also provides consulting and mentoring services to help implement PM as a core competency within the organization. Consulting, mentoring, and training support is provided directly to project teams in the topic areas of project management, risk management, strategic planning, team building, change management, problem solving, and organizational and business development.

In terms of metrics, project managers are evaluated in terms of project slippage, cost delays, project milestones, meeting scope, staying within budget, and team skills. Rewards and recognition are regularly given for successes, and are even given for failures. The organization has challenged and empowered the PM and engineering communities to develop methods and processes to complete projects ten times faster, supporting efforts such as Six Sigma and 10X or Cycle Time Improvement. In terms of bottom-line impact on project outcomes, Project Managers report to the Corporate Council every six weeks to show improvements by percentage. Gains are measured on

cycle time baselines in terms of number of project completed on time, slippage of late previous periods, meeting scope, and staying within budget.

- **Company 5**

Company 5 has possessed a development process since the inception of the company in the 1950s, mainly due to the nature of the work and the sophistication level of the clients. The company has discovered that project management is the best way to handle change and complexity for the organization. Office managers are driving the requirement for a PM development and certification program because they are looking for a tool to communicate expectations to the staff and develop them to identified competencies. It is seen as a valuable management initiative, and has the backing of senior executives.

The PM competency model is recognized as a critical element for their program, since there is only a freestanding curriculum in place. In terms of career levels for project managers, there is an informal distinction between junior and senior level capabilities. The organization is in the process of incentivizing and formally identifying the milestones during a PM career, and coordinating with the HR department in the identification of career paths. Upcoming initiatives include defining eligibility requirements, creating competency definitions, and driving towards the goal of creating a mandatory PM certification process.

The current project management initiative is Web-based distance learning centered, with new modules being fielded on a regular basis. Convenience and the timing of training delivery (just what's needed, just in time) is driving the curriculum development process, so Web-based module development is being pursued aggressively across the company. All of the training modules are internally developed, because the company discovered that the majority of off-the-shelf products were not tailored enough towards company requirements, and were boring and generic. The company collaborated with a web authoring company to put subject matter on the web for them. This identified experts from across the company in particular subject areas. The distance-learning curriculum covers the following topic areas:

- Functional technical skills
- Consultative selling
- Risk management
- Finance and budget
- Team management

- **Company 6**

Company 6 has developed their program in the context of business change with the new CEO. The organization does not currently have a profession of defined project managers except in the IT sector, but more and more positions are being created and identified as project management related, with compensation identified as a critical issue. In general, Company 6 envisions an internal group of PMs who possess deep skills and can act as

mentors, and another group that will move in and out of project management. This means that a professional core of PMs will manage the bigger projects while others will manager smaller, less risky projects. The organization is looking at defining the career paths later in 2001.

The organization has a modest PM curriculum in place; both internally developed and externally contracted with training vendors. PMI certification was originally encouraged, but the organization feels that it complicates the internal process. The organization stays true to about 70 percent of the PMBOK, with internal emphasis on the more applicable elements driving creation of internal solutions. The company encourages self-development, and reimburses personnel to pass the PMP examination if they desire.

The organization considers itself relatively early in the PM maturity model, since they are still defining the PM process, and since their PM competency model has not been blessed across the different company sectors. The corporate goal is standardization of the PM process and language, and they are working towards achieving buy-in across all business processes and functional areas and are expanding to include project support personnel. The original project management development process was overhauled in light of the need for quicker turnaround in terms of business imperatives, primarily market responsiveness. The new model emphasizes the development of project managers who can work within a self-funding project cycle requiring tangible benefits at each phase of the project in order to fund the next cycle of related projects. Company 6 does not currently certify their PMs, but is driving towards it through the design of a model that emphasizes different levels of capability split across different business processes and functional areas, building in flexibility through overarching processes and allowing discretionary practices and requirements as needed.

Company 6 views the systems approach of project management as critical, with integration into the HR processes as essential. Currently, PM training is under HR, but HR does not control the business processes for PM within the organization, and thus must rely on the business divisions in communicating accurate resource requirements. The business metrics of the impact of project management development are not in place yet, but the initial metrics will focus on the PMs at the level of training and development. Improved organizational success is viewed as an increased capability by PMs in selecting projects based on more realistic and pragmatic outcomes, with these success metrics and lessons learned folded back into the development and certification process for other projects to learn from.

Table 2 on the following pages provides a comparison of the project manager training and certification processes that are used by the two Federal agencies and six private companies included in the benchmarking study. It is noteworthy that all agencies/companies in the sample implement the project manager certification organization-wide, although none of the organizations allow “grandfathering.” Four of the six private companies have a mandatory certification process for their project managers. Although both Federal agencies currently encourage certification, they are working toward a mandatory requirement in the future. Half of the organizations surveyed have two or more levels of certification.

All organizations in the benchmarking sample indicated that they have, or are in the process of developing, agency or company-specific project manager competencies. In most cases the intent was to have an individualized internal certification process, although many of the organizations supported an equivalent external source such as PMI or DAU. In all cases, the Federal agencies and private companies have a formal training program in place to develop project managers and to serve their certification process. Several of the organizations also have policies on re-certification.

In describing the organizational project management development and certification process, the study found that the participating organizations were at various stages of maturity in their development and certification processes. Several programs were long-standing, but changes in terms of education, training, and experience criteria were an ongoing process for these organizations, and was often valued as a strategic imperative by senior management.

Table 2 Comparison of Project Manager Training and Certification Processes for Benchmarked Federal Government Agencies and Private Industry Companies							
Organization	Range of Impact	Organizational Requirement	Levels of Certification	Certification Vehicles	Competency Definition	Collaboration	Curriculum Delivery
Federal Government Agencies							
Department of Defense: Naval Facilities Command (NAVFAC) U.S. Army Corps of Engineers (USACE)	Entire organization	Certification required for selection of assignments and promotion	3 levels defined by DAU	Adopted DOD development and certification program Currently identifying best practices in project management development & certification organization wide Several stand alone efforts within organization		Defense Acquisition University	Residential Training
General Services Administration	Entire Organization	Encouraged	One level Working on levels	Individual development plans Supports PMP	Skills and traits developed by GSA Project Manager Center for Expertise	HR (University for People)	Internal training Outsource vendors for instruction
Private Industry Companies							

Table 2 Comparison of Project Manager Training and Certification Processes for Benchmarked Federal Government Agencies and Private Industry Companies							
Organization	Range of Impact	Organizational Requirement	Levels of Certification	Certification Vehicles	Competency Definition	Collaboration	Curriculum Delivery
Company 1	Entire Organization	Level 1 training required for all outside hires Level 2 required in the future	One level	None PMP supported	Competence based level 1 course	HR	Three levels of internal training
Company 2	Entire Organization	Mandatory	3 levels	Internal and PMP (Level 3 only)	Multi-level competencies	Internal with HR	Residence Training
Company 3	Entire Organization	Qualified, certified and re-certified	One level	Internal experience summary submitted to a committee PMP and DOD Level III Certification accepted as equivalents	Entry and Qualification Basic Knowledge and Awareness Ability to perform with assistance Ability to perform without assistance Ability to advise and lead others		Experience and resident training
Company 4	Entire Organization	Desired	5 levels	Project management Professional (PMP) Collaboration with ESI and GWU (Certificates and Masters' Certificates)	Nine competencies and 12 general management competencies	ESI International George Washington University (GWU) (Master's degrees and certificates) PMI	Motorola University (residential workshops) Web based CD-ROM

Table 2 Comparison of Project Manager Training and Certification Processes for Benchmarked Federal Government Agencies and Private Industry Companies							
Organization	Range of Impact	Organizational Requirement	Levels of Certification	Certification Vehicles	Competency Definition	Collaboration	Curriculum Delivery
Company 5	Entire Organization	Working toward mandatory requirements	Not currently defined, but have defined two levels of capabilities (junior and senior)	None defined	Upcoming initiative to define competencies	Web authoring company	Free standing internally developed curriculum Web based training emphasized
Company 6	Proposed throughout entire organization (2001)	Encouraged	One level	PMP (optional)	Under development	Internal with HR	Internal and contracted

Discussion

The agencies and corporations that participated in this study were at various stages of maturity in their project management development and certification processes. Most were in early stages of developing competence-based project management education programs and related certification programs. Several certification programs were long-standing, but ongoing changes in terms of education, training, and experience continue, and both the programs and the changes were often valued as a strategic imperative by senior management. The new and incomplete character of most of the certification programs raises the question whether the perceived benefits of formal, universal certification are only hopeful expectations rather than being built on long experience.

The most fully developed certification programs among the respondents are at Company 3 and DoD (using the DAU competencies). The DoD and Company 3 are large, long-established organizations, one an agency and one a corporation, that both grew rapidly beginning in the 1940's. Both have long had reputations for highly structured and hierarchical cultures; both are famous even for their uniforms. The success of formal certification of project managers in these environments may be traceable to their pre-existing formal environments, and thus may not constitute a good recommendation of formal certification to NASA, unless NASA leadership decides that greater consistency and structure in project management is needed across Centers, or that the consistent levels of project management expertise would actually permit more flexibility of assignment, team making and control of mistakes.

Competency-based Certification and Career Development of Project Managers

A number of themes of project management development and certification programs emerged from the interviews conducted with the organizations in this study. First was the emphasis on a competency-based approach. All of the organizations relied on or were developing competencies of some sort as the basis of their PM development and certification efforts. Most of the organizations relied on external, partial, or test-based forms of competencies, unlike NASA's customized, performance-based and individualizable competencies. Second, career development rather than traditional training characterized the best development and certification programs.

Perceived Benefits:

- Performance is a discriminator in decision-making
- Consistent and recognized definition of capability across the organization, and by industry and customers
- Enhanced confidence in the capabilities of project managers
- Consistency in what they can do and what they know
- Common project management vision and language that can be used across the organization
- Allows for keeping up with the rapid development of technology

- Provides a foundation for effective project management development and mentoring, allows for the development of communities of practice and in turn develops a knowledge management infrastructure
- Transforms the company to become project-based, well beyond simply running projects
- Encourages the asking of hard questions in a non-attributional environment
- Defines clear professional career paths for project management professionals
- Achieves competitive advantage for individuals in terms of promotions and assignments
- Provides an opportunity to add another dimension to recognition & retention programs
- Benefits are clearly seen and supported by management and employees
- Provides an effective basis to measure the project management skills and experience of individuals and organizations including external validation by organizations such as PMI
- Provides higher capability in successfully managing critical projects for the company

Problems for the Organization:

- Technical management requirements in functional areas are difficult to capture and time-consuming to define, with many similar concepts holding different names
- It is difficult to define a common language and processes for a large number of people
- Underestimation of the power of resident courses in creating and maintaining an effective culture. It is often sacrificed simply due to budgetary pressure and inability to quantify the difficult metrics of organizational impact of training
- Mid-level bureaucrats are typically resistant
- Continuing education requirements beyond the top level are usually non-existent
- There is a tendency for over-reliance on tools rather than a true integration of the cultural and system element
- Achieving buy-in at all organizational levels is a problem, where it is easier to intellectually agree but not truly support the effort
- The mentality that a formalized project management development and certification process gets in the way of creative collaboration causes problems
- Cross-company teams that involve management, technical, and project manager skills must resolve integration issues in career progression, with project management skills possibly cutting across functional areas

- Organizational issues impact the practice of Project Management, such as centralized versus decentralized control, horizontal and vertical integration issues, and matrixed resources
- Bureaucracy and administration requirements are a problem, making project management development and certification impossible
- Management education on the project management development and certification process, with emphasis at the middle management level in overcoming reliance on intuition and gut feel
- Creation of a trusting environment and encouraging management culpability in failures
- Allowing project managers to be trained and certified
- Use leaders' time to serve as teachers and mentors
- The lack of a forcing function to make it happen
- Very difficult to administer an effective program that does not have a centralized champion within the company ensuring that the program is meeting the objectives set out for it
- People are accustomed to attending traditional training as a break from work, and now realize it is a different environment where performance is critical and will be measured
- An organization that has undergone several significant reorganizations that have eliminated entire divisions, losing several significant improvements that never had a chance to come to fruition
- Senior management tends to pull away and reassign personnel that show project management capability, thus removing talented people from managers who are left with a less-than-optimal view of developmental and certification activities
- A problem with implementing a systematic project management development and certification program is that it simply takes time for project managers to learn and perform, and the organization is taking a risk in assigning new project managers. The organization must be tolerant of mistakes, and must build in safety nets, such as management emphasis on using organizational resources to solve project problems

Competencies

Competencies are specific knowledge, skills, abilities, characteristics, attitudes and behaviors that enhance job performance for particular roles within an organization. Organizations that manage the development of capabilities through competencies can gain critical competitive advantage in business processes such as recruiting, retaining, and motivating high-performers. In tailoring competency models for organizations, they can have a variety of scopes, with some models identifying core competencies required for all levels of a workforce, while other models focus more on developing competencies for a specific unit, type of job, or position. A

competency-based framework is the backbone of an effective PM development and certification program, and all organizations had models ranging from two-level basic and advanced models to five-level models emphasizing a progression from basic knowledge to the ability to teach others at the top level.

Recommendations:

- Define common knowledge and common requirements across the entire organization and create strong competency frameworks
- Careful and valid definition of the competency and capabilities and the requirements at each level. Development will naturally follow once a strong foundation has been created
- Develop a competency-based project management development model
- Create a strong competency-based training model
- Standardize the language and project management processes as much as possible
- The careful development of clear goals, roles, and responsibilities defined for both contractors and NASA

Assessment and Certification Programs

Another theme was the finding that all organizations were either moving towards a formalized and rigorously defined project management assessment and certification program, or already possessed one. Assessment and certification was viewed as a management tool that allowed managers to have faith that a minimum level of capability is present and that a common language and set of tools is used across the project management workforce. The organizations varied in their levels of certification, use of external assessment and certification organizations and resources (such as PMI), the level of enforcement of assessment and certification standards, the definitions of various stages of certification and re-certification, and how equivalencies are defined and granted. The strongest programs had tailored their approach across different elements of the greater organization, and had devoted tremendous amounts of time and effort in collaborating with and updating the stakeholders. In terms of granting equivalencies for identified components of a development and certification model, all organizations permitted waivers and exceptions, but universally prevented grandfathering of experienced personnel into the programs. Grandfathering was seen as diluting the potential and cultural importance of the programs.

Recommendations:

Certification

- Plan towards mandatory certification
- Distinguish between qualification and certification, with the latter being advanced in nature

Career Development

- Adopt an existing career development process if possible, since all models tend to have common and already identified components
- Develop a project management career path that covers roles and responsibilities, rotation assignments, standard tools and techniques
- Practitioners must be educated about the level of commitment required

Include Prior Experiences

- Prevent grandfathering, since it impedes the transmission of organizational culture. Carefully define equivalencies and exemptions with each component organization
- Carefully define equivalencies, but do not grandfather project managers. Offer fast start courses for more experienced Senior Management personnel to speed up the certification process

Executive-level Support

Executive-level support was a common thread across the organizations, but it did not necessarily come at the beginning of a PM development and certification program. In fact, most programs were started as pilot programs or voluntary efforts that eventually attracted the attention of senior management, beginning at a grass-roots level. When the programs achieved senior management visibility, the maturity of the process was sufficient to export across the greater organization. It is especially important to note that all organizations identified initial resistance to any perceived mandated developmental program, as well as ongoing resistance at middle management level. Small successes along the way ensured that the best programs were integrated into the culture of the greater organization, and that the process owners were spread across the organization, incorporating the majority of functions.

Recommendations:

Management and Senior Level Involvement

- High-level executive sponsorship
- Obtain senior management sponsorship
- Use a steering committee at senior management level to achieve continued emphasis

Vision and Planning

- The creation of a total environment with a strong supporting structure is critical, to include tools and techniques
- A systems approach integrating people, process, and tools should be emphasized as a major business transformation challenge
- Tie the program to the strategic plan
- Concentrate on culture change, or the effort will fail

External Resources

External resources such as PMI were identified as valuable in terms of organizing the body of knowledge required for project managers, but was deemed as only part of the solution. Several organizations supported external certification as part of their internal program, while others required an external certification at certain levels of their development model. Both approaches seemed to satisfy the respondent organizations, but extensive tailoring was accomplished in order to contextualize the competency model for the organization. The majority of organizations devoted resources for employees who wanted to pursue external certification, of which PMI was cited as the most popular alternative. All organizations cautioned that a certification program, such as the PMI PMP program, should be identified as only one part of a larger comprehensive PM development and certification approach for the organization. Many organizations make the mistake of trying to take the easy way out through a quick fix of requiring external certification.

Recommendations:

Partnerships

- Find a partner such as ESI International and George Washington University
- Create strategic partnerships with external partners, such as universities, government agencies, and the private sector
- Incorporate a strong team leadership component emphasizing Integrated Product Team processes, and train at the team level as part of the development process

Human Resource Department Integration

Integration into HR processes was deemed critical by all organizations. It seems that the tighter this integration was, the better the alignment of the organization in terms of strategic business goals. Zemke and Zemke (1999) specified that the decisive test for any type of competency development model is whether and how well the model fits into the organization's performance management system. For the organizations in this study, this systems view of PM development and HR business processes is seen as an ongoing requirement in order to clearly articulate the relationship between job descriptions, recruiting of new personnel, retention of seasoned project managers, and proper compensation, incentives, and rewards for exceptional performance.

Recommendation:

- Full integration into Human Resources

Instructional Design and Implementation: Tools and Techniques

Project management tools and techniques were seen as valuable elements of the programs studied, and the most successful programs attempted to field tools and techniques in parallel with the developmental and certification programs. Several organizations warned of the trap of using tools and techniques, such as an enterprise-wide PM Information technology system, as the

definition of the total program. Education about emerging and new tools and techniques was also seen as a major element in any ongoing career development activity in terms of re-certification and continuing education.

Recommendations:

- Try to have tools available to roll out at the same time the methodology is rolled out, and keep putting more tools and content on the Web
- Divisions such as IT will try to convince you that buying a good PM tool is all that is required for good project management. Company 2 almost fell into this trap
- There is a tendency for over-reliance on tools rather than a true integration of the cultural and system elements
- Leverage the Web as much as possible for training and tool delivery
- Readily available training and tools
- Carefully set criteria for outsourcing Web-based content
- Use in-house subject matter experts to develop the content and outsource the Web formatting of the lesson plans
- Achieve buy-in with all stakeholders early in the process
- Integrate performance ratings and developmental plans
- Try to establish a system that forces usage of materials
- Carefully involve management in the development of the program and in the delivery
- Balance Web-based elements with traditional resident training modules
- Develop contractor and client contingency
- Meaningful support and review process that discourages “dog and pony shows”
- Use knowledgeable people
- Make it supportive rather than audit
- Rotation of individuals
- Emphasize contract administration
- Identify a strong process for change management because of the competing requirements during implementation, individual rice bowls, and major restructuring of business processes at this level. Manager’s Workshops are essential.
- As the process matures, other communities buy into the process, such as the consultant community and architect community for Company 2.
- Knowledge management is also viewed as a giveback activity, and needs to be measured at a certifying board level
- Develop trust and synergy through a systems approach

- Communities of practice become increasingly important as the process matures, and maintain the momentum in changing from the prescriptive mode

Mentoring

Mentoring was identified as a critical component of several programs. This was situated in the organization as giving back, and as a critical element in creating strong communities of practice and allowing for the transfer of best practices, leading to creation of a knowledge management framework. The mentoring activity was used as a feedback loop into these PM development and certification models, adding the value of perspective on successes and failures to the development of new project managers within the organizations in the study. The majority of organizations did not have a formal mentoring process in place that includes metrics on the effectiveness of their mentor.

Recommendations:

- Managers must be encouraged to embrace new behaviors, such as mentorship
- Mentoring is a key component of the process and needs to be measured as a giveback activity, reviewed at board level
- Include a strong mentoring capability

Summary – Comparison with NASA’s PMDP

Table 3 below provides a comparison of NASA’s progress toward a project manager certification process using the current PMDP with the level of development of the project manager certification processes identified for the organizations participating in the benchmarking study. NASA’s PMDP offers many of the necessary requirements for a certification process, including a competency-based model, a career development pathway and the training infrastructure within APPL. However, many of the required organizational components that are necessary for NASA to implement a formal certification program, either at a center or Agency-wide, are currently at a developmental level.

Table 3 Comparison of NASA PMDP with Benchmarking		
Requirements for a PM Certification Process	Organization	Level of Current Development
A. The development of a tailored PM competency-based development model	NAVFAC USACE	The organization is considering the development of a tailored PM competency model.
	GSA Company 1 Company 5 Company 6	The organization recognizes the importance of a tailored PM competency model, and is in the process of defining the components.
	NASA DoD Company 2 Company 3 Company 4	The organization possesses an operational tailored PM competency model.
B. Internal PM certification process	NASA NAVFAC USACE	The organization is considering the development of a PM certification process.
	Company 1 GSA Company 4 Company 5 Company 6	The organization is developing either a voluntary or mandatory PM certification process.
	DoD Company 2 Company 3	The organization possesses an operational mandatory PM certification process.
C. Executive-level support for the PM development and certification model		The organization does not have executive-level support for the PM development and certification program.
	Company 5 NASA NAVFAC USACE	The organization has executive-level interest in a PM development and certification program.
	Company 1 DoD GSA Company 2 Company 3	The organization possesses the commitment and representation of executives for the PM development and certification program
D. Use of external PM development and certification resources		The organization is considering the inclusion of external resources.

Table 3 Comparison of NASA PMDP with Benchmarking		
Requirements for a PM Certification Process	Organization	Level of Current Development
	Company 1 Company 3 Company 5 Company 6 USACE NAVFAC NASA	The organization recognizes the importance of external resources, and uses them on a voluntary basis.
	DoD GSA Company 2 Company 4	The organization leverages external resources and applies them at specific levels and components of the PM development and certification program.
E. Integration into HR business processes	NASA	The organization is developing a PM development and certification program independent of the HR department.
	GSA USACE NAVFAC Company 5 Company 6	The organization recognizes the importance of integration into the HR business processes, and is in the process of developing the working relationship.
	Company 1 DoD Company 2 Company 3 Company 4	The organization integrates the PM development and certification program into HR performance management business processes.
F. Issues concerning the granting of equivalencies		The organization does not have equivalencies and waivers defined.

Table 3 Comparison of NASA PMDP with Benchmarking		
Requirements for a PM Certification Process	Organization	Level of Current Development
	GSA Company 5 Company 6 USACE NAVFAC NASA	The organization is in the process of determining what the appropriate equivalencies and waivers should be at each level and component of the PM development and certification program.
	Company 1 DoD Company 2 Company 3 Company 4	The organization possesses an operational system of definitions and processes for the granting of equivalencies and waivers.
G. Identification, development, and application of PM tools and techniques	USACE NAVFAC	The organization has not identified, developed, or implemented PM tools and techniques in a centralized, systematic fashion.
	DoD GSA Company 2 Company 3 Company 4 Company 5 Company 6 NASA	The organization is in the process of identifying, developing, and implementing PM tools and techniques.
	Company 1	The organization fields PM tools and techniques in parallel with their PM development and certification program.
H. Implementation of a systems approach		The organization does not possess an integrated vision and plan of the interfaces required for the PM development and certification program.

Table 3 Comparison of NASA PMDP with Benchmarking		
Requirements for a PM Certification Process	Organization	Level of Current Development
	GSA Company 5 Company 6 USACE NAVFAC NASA	The organization is defining the interfaces required for their PM development and certification program.
	Company 1 DoD Company 2 Company 3 Company 4	The organization possesses an operational vision and definition of required interfaces for their PM development and certification program, and possesses an action plan to meet their needs.
I. Use of mentoring.	Company 5 USACE NAVFAC	The organization is considering the development of a mentoring component for their PM development and implementation program.
	Company 1 DoD Company 3 Company 6 NASA	The organization recognizes the importance of mentoring, and is developing a voluntary mentoring component for their PM development and certification program.
	GSA Company 2 Company 4	The organization possesses an operational mentoring component, to include metrics.
J. Development of a knowledge management infrastructure.	USACE NAVFAC	The organization is considering the development of a knowledge management infrastructure to capture best and emerging practices.

Table 3 Comparison of NASA PMDP with Benchmarking		
Requirements for a PM Certification Process	Organization	Level of Current Development
	Company 1 DoD GSA Company 2 Company 3 Company 5 Company 6	The organization is developing a knowledge management infrastructure for capturing best and emerging practices.
	Company 4 NASA	The organization possesses an operational knowledge management system that captures best and emerging practices.

OPTIONS FOR NASA PROJECT MANAGEMENT CERTIFICATION

The previous sections of this report provided a detailed discussion of the history of project management within NASA, including project management career development and training within the organization. The benchmarking study of industry and government organizations identified the current state of the art in project management certification in the United States. This benchmarking study resulted in a series of observations related to each organization's efforts in developing certification, and a series of recommendations to NASA on how to avoid some of the problems experienced by other organizations. The lessons learned pointed out both successes and failures related to the various requirements and needs of the individual organizations.

It is important to note that the organizations making these recommendations represent a wide spectrum of career development and certification models, and as such, their recommendations represent a wide range of experiences – from organizations with a great deal more experience than NASA in project management, to some with a great deal less. No organizations that had not opted to provide project management certification activities were included in the benchmarking study, so there may be a natural bias toward increasing the level of involvement in certification activities.

Based on this information, the following courses of action are presented for NASA leadership to consider as they evaluate options of Project Management Certification. This wide spectrum of options reflects the wide range of opinions on certification. Regardless of the approach, it is essential that NASA leadership make a clear and directed decision on what is required to be a Project Manager at the National Aeronautics and Space Administration. A partial decision will promote the current confusion and doom any approach to failure. Such a critical decision must ultimately be determined through coordination of the NASA Administrator, Enterprise Associate Administrators, Chief Engineer, Chief Scientist, Human Resources and Education, Program Management Council, Program Management Council Working Group and Center Directors.

The following options reflect increasing levels of effort, from maintaining the status quo, to developing simple modifications and fine-tuning existing elements within the Agency, to a more global certification program mandated for all NASA Project Managers.

Option 1:

Maintain status quo through continuation of the current voluntary status and structure of the programs in place across the Agency, including the NASA Academy of Program and Project Leadership.

Advantages:

1. No additional resource requirements

This approach has no impact on resources – human and budgetary. This emphasizes the ongoing development of existing courses, learning experiences and involvement by employees involved in project management activities. Individual development continues to occur “as work allows”, with no assumed increase in demand or participation. This alternative also requires the least amount of coordination and additional effort across NASA.

2. Limits additional overhead requirements on the project workforce

Any approach toward certification will require at least some individual effort. People will continue to need the time to document work experiences. Centers will need to establish time to review, assess, recommend and develop development strategies to achieve certification. Employees will expect time is available to receive required training and development experiences.

3. No expectations to manage

In a system without requirements and discipline, there is no standard to meet. Consequently, managers do not need to worry about managing employee expectations.

4. No impact on selections

Managers will continue to be unconstrained in their selection of project managers or other project personnel.

Weaknesses:

1. Lack of discipline

The greatest potential weakness of the current system is that there are no agency standards applied to the selection and development of project managers. In an organization that spends billions of taxpayer dollars through the management of projects NASA’s unsystematic approach can create the appearance of a significant problem. Beyond the appearance issues, the lack of discipline may result in selecting project managers who are unprepared in the methodology of project management, e.g. risk management, cost management, planning and scheduling. The lack of discipline also prevents employees from clearly understanding what is expected of them if they want to be a project manager.

2. Ignore public reports

In two of the four recent failure reports, findings encouraged NASA to consider some form of project manager certification. Maintenance of the current approach ignores

these recommendations. Furthermore, it is likely that future committee reports will continue to recommend some form of certification.

3. Lack of driving force for improvement

This approach maintains the status quo and does not introduce a driving force for improvement in terms of project performance and project manager capability. All of the organizations in this benchmarking study are moving towards or already possess a mandatory and formal PM development and certification process. The study results reflect the fact that organizations make a conscious effort to improve in terms of project management capability, and that decision requires a commitment by the entire organization, not individual units or sectors.

4. Lack of agency integration and coordination

The lack of a disciplined agency approach to certification will further encourage development of a disparate array of options used at the field center level. Continued divergence of Center approaches can undermine agency direction and waste resources through uncoordinated investment in capability development.

5. Inability to manage a critical community

The lack of recognized agency competency standards for the project management community may suggest an inability to collaboratively determine and manage requirements and standards.

Option 2:

Establish and aggressively promote project management certification maintaining certification as a desirable, but not mandatory basis for selection.

Advantages:

1. Evolution of current process

The current NASA Project Management development system is robust and strong in its offerings. The weakness of the current system is based mostly on the lack of management emphasis and utilization of existing resources. A strong link between development and management direction would largely accomplish the benefits of full certification. The recently revised PMDP competencies and upgraded courses lend themselves to voluntary use in selections and individual performance plans. NASA could elect to gradually incorporate these elements into existing management practices.

2. Limited additional resources

Since the majority of costs to develop the career model and curriculum are sunk costs that are currently covered through the NASA Academy of Program Project Leadership (APPL), emphasis on the implementation of voluntary certification would limit the additional investments. Increased participation in the voluntary certification would, however, require additional investments in mentoring, administering, on the job training, and attendance of formal development events.

3. Limits resistance

An evolutionary, voluntary approach would significantly eliminate resistance to change.

4. Builds on current grassroots support

This approach builds on the current community of project practitioners who have received certification through the Project Management Development Process (PMDP). A recent focus group of senior agency project practitioners strongly expressed the opinion that certification or training was necessary but not sufficient criteria for selection of project managers.

5. Establishes and promotes project manager certification consistent with industry trends

The informal approach relies on an evolutionary model for achieving broad certification. Over a period of time it is expected that a significant percentage of practitioners would be certified and the culture will enforce broader certification. NASA will come into alignment with many industry and government organizations that promote project management certification.

Weaknesses:

1. Potential for uneven implementation to reduce the effectiveness of certification

Some individuals (as is currently the case) will significantly benefit from planned work experiences and development, others will be told to forget about it and just do their jobs. Realization of the benefits of workforce development will continue to be a function of where one works and for whom one works.

2. Extends time by relying on management support and grassroots effort

The evolutionary approach will take longer to achieve, if NASA is serious about PM certification. In our culture it is unlikely that all managers will be capable and/or motivated to support such a strategy. This will once again place the demand on the workforce to implement leader direction. Such an approach would work effectively only if Enterprise leaders and Center Directors are strongly supportive.

3. Continues perceived void of leadership direction and failure to learn from past mistakes

An evolutionary approach to project manager certification will be criticized in some quarters as indicating a lack of ability to make a definitive decision and an unwillingness to learn from past failures.

Option 3:

Develop and implement a NASA-mandated PM development and certification system, with specific requirements, standardized tools and techniques, and a centralized database of certified Project Managers that are to be used in selecting program or project managers, according to defined scope and resource allocation criteria. This program would be implemented within the time span of a mandatory transition window.

Advantages:

1. Establishes unambiguous support for certification

This approach maintains a level of consistency across NASA programs and projects, while addressing specific interests. As a result, this encourages buy-in to the certification activities by elements that have consistently perceived themselves as separate and distinct units.

2. Establishes NASA rigor and discipline

A formal certification process will answer specifically what is expected of individuals who become project managers. Such an option would ensure at least minimal experience and educational standards for a workforce that is responsible for the majority of NASA's budget.

3. Consistent with external organizational trends

As stated within the formal report, organizations that depend on project management are increasingly establishing standards associated with certification. It is increasingly common for organizations to require certification before an individual can be selected to a position.

4. Addresses external expectations related to NASA project management

NASA is considered one of the preeminent project organizations in the world. It is likely that there will be continuing pressures to ensure that NASA has a form of certification. In the event that NASA maintains the status quo the probability is high that NASA will eventually be forced into an externally mandated approach.

Weaknesses:

1. Will require significant additional resources

This approach takes time to work with each major internal stakeholder on developing a tailored model that will meet NASA requirements while addressing specific interests. Demand for required training and development experiences can be expected to increase, in some locations to a great degree. The results of this study indicate that this is the approach the majority of organizations implemented or desire to implement, but the time and effort expended are significant for NASA. This approach also requires visible senior leadership emphasis and support in order to succeed.

2. Resistance will be greatest in this option

Based on the discipline of this approach, it is likely to produce the greatest opposition. It will require the greatest change from the NASA norm. The introduction of mandatory criteria will necessarily limit management flexibility in selections.

3. Demands addressing the issue of “grandfathering”

As has been pointed out throughout this report, a consistent finding has been the problems regarding “grandfathering” of experience. Most organizations that established certification requirements indicated “grandfathering” was a mistake and should be avoided. Nonetheless, some process would need to be in place to accommodate the advanced experience level of many NASA practitioners.

4. Danger of “box-checking” mentality

A formal certification process is likely to create the potential for practitioners becoming more concerned with checking the box than with their professional development and preparation. There is a danger that the quality of development experience will fall victim to the quantity as demand for this experience grows. Certification would have to be seen as a necessary but not sufficient form of capability.

5. Potential legal considerations

Consideration would have to be given to potential legal and union issues.

Concluding Remarks

The issue of project management certification is a highly volatile topic. There are strong advocates and accompanying arguments on both sides. The intent of this report was to be descriptive as opposed to prescriptive. Consequently, the report describes certification approaches implemented by a variety of organizations currently using some form of certification. The report also tries to point out some of the advantages and weaknesses of any option taken.

It is clear that there is no one solution that will appeal to all. NASA leadership must make the decision based on organization direction, consideration of resource implications and benefits of

project manager preparation and standards. It is also likely that there are variants that go past the three general options considered above. Whatever the decision, a consistent and singular NASA response should be encouraged and supported across the system.

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ACRONYMS

APMC	Advanced Program Management Course
APPL	Academy of Program and Project Leadership
BPA	Business Purchase Agreement
BS	Bachelor of Science
BS/BA	Bachelor of Science/Bachelor of Arts
CD-ROM	Compact Disk - Read Only Memory
CEO	Chief Executive Officer
CFO	Chief Financial Officer
DAU	Defense Acquisition University
DAWIA	Defense Acquisition Workforce Improvement Act
DOD	Department of Defense
DSMC	Defense Systems Management College
GPRA	Government Performance and Results Act
GSA	General Services Administration
HR	Human Resources
IDP	Individual Development Plans
IPMA	International Project Management Association
IPT	Integrated Product Teams
IT	Information Technology
KSA	Knowledge, Skills, and Abilities
MBA	Masters of Business Administration
MOBIS	Management, Organizational and Business Improvement Services
NASA	National Aeronautics and Space Administration
NAVFAC	Naval Facilities Command
NPR	National Performance Review
PM	Project Manager/Project Management
PMBOK	Project Management Body of Knowledge
PMDP	Project Management Development Process
PMI	Project Management Institute
PMP	Project Management Professional
PO	Purchase Orders
PPMI	Program and Project Management Initiative
PR	Purchase Request
SOP	Standard Operating Procedure
USACE	United States Army Corps of Engineers